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SAN FRANCISCO
RECYCLED WATER MASTER PLAN
AND
GROUNDWATER MASTER PLAN
Draft Environmental Impact Report

92.371E
State Clearinghouse No. 940123049

City and County of San Francisco
Department of City Planning

Draft EIR Publication Date: November 1, 1996
Draft EIR Public Hearing Date: December 5, 1996
Draft EIR Public Comment Period: November 1 - December 16, 1996

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DATE: November 1, 1996

TO: Distribution List for San Francisco Recycled Water Master Plan and Groundwater Master Plan Draft EIR - File No. 92.371E

FROM: Paul Maltzer, Office of Environmental Review

SUBJECT: Request for Final Environmental Impact Report

This is the Draft Environmental Impact Report (EIR) for the San Francisco Recycled Water Master Plan and Groundwater Master Plan. A public hearing will be held on December 5, 1996, by the City Planning Commission, to solicit public comment on the adequacy and accuracy of this document. After the public hearing, our office will prepare and publish a document titled "Summary of Comments and Responses" which will contain a summary of all relevant comments on this Draft EIR and our responses to those comments; it may also specify changes to this Draft EIR. Public agencies and members of the public who testify at the hearing on the Draft EIR will automatically receive a copy of the Comments and Responses document, along with notice of the date reserved for certification (i.e., completion) of the EIR. Others may receive such copies and notice on request or by visiting our office. This Draft EIR, together with the Summary of Comments and Responses document will be considered by the City Planning Commission in an advertised public meeting and certified as a Final EIR if deemed adequate.

After certification, a single document called the Final EIR will be produced. The Final EIR will consist of the Draft EIR (as modified by the Comments and Responses document) together with the Comments and Responses document. The Final EIR will add no new information to the combination of the two documents except to reproduce the certification Motion by the City Planning Commission. The Final EIR will simply provide the information in one rather than two documents. Therefore, if you receive a copy of the Comments and Responses document in addition to this copy of the Draft EIR, you will technically have a copy of the Final EIR.

We are aware that many people who receive the Draft EIR and Summary of Comments and Responses have no interest in receiving virtually the same information after the EIR has been certified. To avoid expending money and paper needlessly, we would like to send copies of the Final EIR to private individuals only if they request them. It is likely that the Department will require payment for the Final EIR, to cover production costs. If you would like to be contacted regarding purchase of a copy of the Final EIR, therefore, please complete, fold, seal and mail the enclosed request form to the Office of Environmental Review within two weeks after certification of the EIR.

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Attn: Paul Maltzer, EIR Coordinator
92.371E - San Francisco Recycled Water Master Plan
And Groundwater Master Plan Draft EIR

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REQUEST FOR CONTACT REGARDING FINAL ENVIRONMENTAL IMPACT REPORT

TO: The Planning Department
Office of Environmental Review
Attn: Paul Maltzer

Please contact me regarding the availability of the Final Environmental Impact Report for the San Francisco Recycled Water Master Plan And Groundwater Master Plan. I understand that a fee may be required for this document.

Signed: _____

Please print name and address:

SAN FRANCISCO
RECYCLED WATER MASTER PLAN
AND GROUNDWATER MASTER PLAN
Draft Environmental Impact Report

92.371E
State Clearinghouse No. 94123049

City and County of San Francisco
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GLOSSARY

ACRONYMS OR ABBREVIATIONS

AB - Assembly Bill

ABAG - Association of Bay Area Governments

ac-ft/yr - acre-feet per year

AWSS - Auxiliary Water Supply System

BAAQMD - Bay Area Air Quality Management District

BART - Bay Area Rapid Transit

BAWUA - Bay Area Water Users Association

BMP - Best Management Practices

CCR - California Code of Regulations

CEQA - California Environmental Quality Act

CFR - Code of Federal Regulations

CFS - cubic feet per second

CVPIA - Central Valley Improvement Project Act

DOHS - California Department of Health Services

DPT - San Francisco Department of Parking and Traffic

DPW - San Francisco Department of Public Works

DWR - California Department of Water Resources

EIR - Environmental Impact Report

EPA - Environmental Protection Agency

ft/dy - feet per day

FERC - Federal Energy Regulatory Commission

GIS - Geographic Information Service

gpcpd - gallons per capita per day

gpm - gallons per minute

GWMP - Groundwater Master Plan

HVAC - Heating, Ventilation and Air Conditioning

kVA - kilovolt-amperes

kWh - kilowatt-hours

MCL - maximum contaminant level

mg/L - milligrams per liter

mgd - million gallons per day

MOU - Memorandum of Understanding

MPN - most probable number

msl - mean sea level [NGVD 29]

NGVD - National Geodetic Vertical Datum

NPDES - National Pollutant Discharge Elimination System

NTU - nephelometric turbidity unit

OER - San Francisco Planning Department, Office of Environmental Review

O&M - operation and maintenance

OSHA - Occupational Safety and Health Administration

PUC - San Francisco Public Utilities Commission

P.L. - Public Law

psi - pounds per square inch

PPV - peak particle velocity

QA/QC - Quality Control/Quality Assurance

RWQCB - California Regional Water Quality Control Board

RWMP - Recycled Water Master Plan

RWTP - Recycled Water Treatment Plant

SFFD - San Francisco Fire Department

SFWD - San Francisco Water Department

SWRCB - California State Water Resources Control Board

TDS - total dissolved solids

TSP - total suspended particulates

USEPA - U.S. Environmental Protection Agency

UV - ultraviolet

WDR - Waste Discharge Requirements

WDS - waste discharge systems

WPCP- Water Pollution Control Plant

WQCP - Water Quality Control Plan, also known as Basin Plan

yr - year

DEFINITION OF TERMS

(as used in this EIR)

AB3030 - The Groundwater Management Act (1992, California Water Code 10750 et seq) facilitates and encourages local public water agencies to develop and implement groundwater management plans. The legislation identifies 12 elements that may be included in a groundwater management plan. These elements address evaluation and operation of a groundwater basin with the intent of maximizing the total water supply while protecting groundwater quality.

Aquifer - Saturated rock or sediment that is permeable enough to transmit significant quantities of water to wells and/or springs.

Auxiliary Water Supply System (AWSS) - A separate high-pressure distribution system in the City of San Francisco that provides non-potable water for fire fighting.

Bacteriophage - A microscopic agent that destroys disease-producing bacteria in a living organism and is normally present in domestic sewage.

Bay-Delta Estuary - The waters of San Francisco Bay and the Sacramento/San Joaquin River Delta.

Baseline Conditions - Conditions that serve as a base for measurement for comparisons.

Bay-Delta Hearings - A series of hearings conducted by the State Water Resources Control Board for developing a water allocation plan to protect beneficial uses of the Bay-Delta Estuary. The primary goal of this process is to define the water needs of urban and agricultural users upstream from the Bay-Delta Estuary. San Francisco has been a participant in the hearings as an upstream diverter on the Tuolumne River.

Bio-oxidation - A wastewater or water treatment process involving biological micro-organisms to increase the level of oxygen in the water or wastewater.

CEQA - California Environmental Quality Act. Enacted in 1970, and subsequently amended, CEQA established policies to maintain a quality environment for the people of California now and in the future. CEQA requires public disclosure of potentially significant physical environmental impacts of a proposed project.

Chloride - Anion (a negatively charged atom or group of atoms, or molecule) of element chlorine; usually in dissolved form. The concentration of chloride recommended by the secondary drinking water standard is less than 250 parts per million, and the typical concentration of chloride in saltwater is 30,000 to 35,000 parts per million. Chlorides in high concentrations can be toxic to some plants.

City - The City and County of San Francisco

Clearwell - Storage facility for the treated recycled water at the Recycled Water Treatment Plant.

Coagulation - A wastewater or water treatment process involving addition of chemicals (usually alum or polymer) to promote the formation of particles from suspended materials in the water or wastewater.

Coliform - Bacteria which occur naturally in the intestines of warm-blooded animals, and that serve as indicators of fecal contamination and of the possible presence of pathenogenic organisms.

Confining Layer - A layer or zone of generally low permeability sediments, such as clay, that underlie or overlie more permeable aquifer material, such as sand and gravel. A low-permeability layer retards the vertical movement of groundwater.

Conjunctive Use - The coordinated management of groundwater and surface water supplies to increase the availability of water during periods of need. Surface water supplies used in conjunctive use operations may be obtained from river flows, imported supplies, recycled water, and desalinated water. Groundwater basins may be recharged by "in lieu" means, whereby surplus surface water is used in place of groundwater, or by direct recharge of the water through spreading basins or injection wells.

dBA - A measure of sound in units of decibels (dB) on the A-weighted scale. The A-weighted decibel scale simulates the response of the human ear to various frequencies of sound.

Dewatering - The process of actively pumping or removing groundwater from a localized area. Dewatering is carried out during below-ground construction, in order to keep the construction area free of water. Dewatering is carried out around existing below-ground structures that extend into the water table, in order to prevent water damage to the structure.

Direct Filtration - A wastewater or water treatment process whereby the water passes through filter material (such as sand) so that particles in the water can adsorb onto the filter material. "Direct" filtration is a more simplified filtration process than the one specified in Title 22, Wastewater Reclamation Criteria (1978).

Discharge - The volume of a fluid flowing in a stream, conduit, or through an aquifer past a specific point over a given period of time.

Disinfection - The selective destruction of disease-causing organisms. Disinfection is generally one of the final stages of wastewater and water treatment, and may be accomplished through addition of chlorine (chlorination), ultraviolet radiation, ozonation or through other means.

Disinfected Secondary Effluent - Treated wastewater that has undergone disinfection (inactivation of bacteria and viruses) and secondary treatment (biological oxidation process). In California, it is suitable for selected categories of reuse.

Disinfected Tertiary Effluent - Treated wastewater that has undergone disinfection (inactivation of bacteria and viruses) and tertiary treatment (filtration process to improve the clarity of wastewater). In California, it is suitable for all categories of wastewater reuse. Also referred to as "unrestricted use."

Distribution Pipeline - With respect to the RWMP and GWMP, pipeline which range in diameter from 8" to 16" that delivers water or recycled water to users.

Diurnal - A cycle that occurs daily over a 24-hour period.

Dual Water System - A system which distributes both potable and non-potable water in separate pipelines within the same area for different uses. For example, in the same building, potable water can be delivered to taps for drinking and recycled water can be delivered to toilets for flushing.

Effluent - At a wastewater treatment plant, the effluent is the treated wastewater flow leaving the plant for reuse or discharge.

Environmental Impact Report (EIR) - A detailed evaluation of the potential environmental effects of a proposed project plan as stipulated by the California Environmental Quality Act.

Equalization Storage - Storage facility for the inflow to the treatment plant to compensate for diurnal flow variations.

Evaporation - The physical transformation of water from a liquid to a gaseous state.

Evapotranspiration - All water that is released into the atmosphere by the processes of evaporation and transpiration.

Firm Delivery Yield - The amount of water deliveries that can be sustained without shortage during all historical hydrologic sequences (1921 to 1992). To determine the Firm Delivery Yield for the Hetch Hetchy System, system operation is simulated using increasing water demand assumptions until the system can no longer meet the demand. Demand can not be met when there is no longer reservoir storage or runoff available to fully meet water demand.

Floc Formation or Flocculation - Defined as the process by which chemicals are added to wastewater which enhance the formation of solid particles from suspended matter in the effluent.

Geographic Information System (GIS) - A computer-based information system used to maintain and relate information.

Groundwater - Water that occurs beneath the land surface in pore spaces or fractures of the sediments or rock in which it is situated.

Groundwater Basin - A continuous body of unconsolidated sediments that contain groundwater and the surrounding surface drainage area.

Groundwater, Confined - Water within an aquifer that is under greater than atmospheric pressure due to an overlying relatively impermeable material.

Groundwater Model - A mathematical simulation that represents the physical properties of the aquifer system. Groundwater models use discrete aquifer property estimates of an area in order to simulate, as closely as possible, the natural aquifer system. Groundwater models are often used as tools to evaluate changing conditions based upon natural or man-influenced situations.

Groundwater, Unconfined - Water within an aquifer that has a water table

Hazardous Waste - Discarded material resulting from industrial, commercial, mining, or agricultural operations or from community activities that may pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. The term hazardous waste does not include materials that are specifically exempted from that classification.

Hetch Hetchy System - A series of reservoirs, aqueducts, and hydroelectric plants that capture and convey water from the Tuolumne River watershed into storage reservoirs. The system is owned by the City and County of San Francisco and provides drinking water in the Bay Area and the City of San Francisco.

Hydraulic Conductivity - A measure of the ease with which an aquifer transmits water.

Hypochlorite - A chlorine-based disinfectant which is similar to a strong household bleach.

Impoundments - An enclosure or containment for large volumes of water.

Influent - Something that flows in. At a wastewater treatment plant, the influent is the untreated wastewater that flows into the plant for treatment.

Injection Well - A well into which fluids are introduced under pressure into the surrounding aquifer.

In-lieu Recharge - An approach to recharging a depleted aquifer that supplies surface water to a groundwater user, when a surplus is available, to be used instead of groundwater. This allows the unused groundwater to remain in the basin to be used during times of need.

Ion - An element that has lost or gained an electron and so, has a positive or negative charge. An anion is an ion with a negative electrical charge. A cation is an ion with a positive electrical charge.

Ldn - A day-night average noise level, represents a cumulative measure in decibels (dBA) of community noise during a 24-hour period. It applies weighting factors to account for people's lower tolerance to noise during the night (10 PM to 7 AM).

Monitoring Well - A well constructed for collecting data regarding groundwater conditions. Data that can be collected from monitoring wells include: (1) groundwater samples to evaluate water quality conditions, and (2) groundwater elevation measures to assess the movement of groundwater within a aquifer or the changes in the amount stored in the aquifer.

National Geodectic Vertical Datum of 1929 (NGVD) - A datum maintained by the U.S. Coast and Geodetic Survey which replaces Mean Sea Level. The San Francisco datum is approximately 8.616 feet above NGVD.

Non-potable - Water that is unsafe for human consumption without prior treatment but may have other beneficial uses such as irrigation, firefighting, toilet-flushing, wash water, and climate control.

Nephelometric Turbidity Unit (NTU) - The standard measure of turbidity.

Overdraft - The condition of a groundwater basin in which the amount of groundwater withdrawn under current development exceeds the amount of water that replenishes the basin over a period of time.

Oxidize - A chemical reaction which increases the amount of oxygen to a compound.

Pathogen - A disease-causing agent.

Porter-Cologne - The California Water Quality Control Act which regulates the treatment and disposal of waste into waters of the state.

Potable - Water that is safe for human consumption.

Pressure Zone - Area within a specific range of elevations for determining water service.

Primary Effluent - Effluent from which floating and settleable solids have been removed using physical operations such as screening and sedimentation.

Production Well - A well that extracts groundwater for potable or nonpotable use.

Recharge Area - An area where water from other sources replenishes an aquifer. Sources of water that may recharge an aquifer include: lakes or streams, rainfall, irrigation, leaking pipes, or groundwater inflow.

Reclaimed Water - Water which, as a result of treatment of wastewater, is suitable for direct beneficial use or a controlled use that would not otherwise occur.

Recycled Water - See reclaimed water

Restricted Water - In the context of wastewater reclamation, recycled water that is suitable for certain specified uses.

Saltwater Interface - The boundary between saline and freshwater.

Saltwater Intrusion (Saltwater Encroachment) - The movement of salt water into a body of fresh water. It can occur in either surface water or groundwater bodies.

Saturated Zone - The zone below the water table where the pore spaces are occupied by water.

Screening - A filtering device that serves as the intake portion of a well.

Secondary Effluent - Wastewater or sewage from which organic matter has been removed using biological and chemical processes; has received a higher level of treatment than primary effluent.

Seep - A location where groundwater slowly moves to the ground surface.

Specific Yield - The portion of water in an aquifer that will drain under the influence of gravity and is available to supply groundwater wells.

Subsidence - The sinking of the Earth's surface, which can result from excessive pumping of groundwater.

Surface Water - Water on the ground surface.

Tertiary Effluent - For reclamation in California, tertiary treatment processes must produce effluent which meets Reclamation in criteria specified Title 22 of the California Code of Regulations. Tertiary effluent has undergone primary, secondary and tertiary treatment (floating and settleable solids are removed using screening and sedimentation and organic matter is removed using biological and chemical processes).

Title 22, California Code of Regulations - Regulations implementing the Porter Cologne Water Quality Act (California) for water reclamation and the State Safe Drinking Water Act for drinking water. Sets treatment requirements for reclaimed water based on proposed use, and sets primary and secondary standards for drinking water quality. Standards set to protect the public health and welfare.

Transmission Pipeline - Under the RWMP, pipeline which range in diameter from 18" to 24" that would deliver recycled water from the treatment plant to the reservoirs.

Transpiration - The process of which water absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface.

Turbidity - A measure of the light-transmitting properties of water, also used to indicate the quality of waste discharges and natural waters with respect to colloidal and residual suspended matter.

Unrestricted Water - In the context of Title 22, Wastewater Reclamation Criteria, reclaimed water that is the same as "Disinfected Tertiary Effluent." See Disinfected Tertiary Effluent.

Unsaturated Zone - The zone between the land surface and the water table, where pore spaces are occupied by both air and water.

Valve Vault - An enclosure containing meters, pressure and flow regulating devices, and other equipment needed to regulate the water distribution system.

Water Reuse Requirements - A permit issued by the Regional Water Quality Control Board that specifies conditions, prohibitions, and provisions required to implement a recycled water project.

Watershed - The area of land from which all precipitation and / or runoff drains to a single point.

Water Table - The groundwater surface in an unconfined aquifer; the interface between saturated and unsaturated soil when no relatively impermeable soil layers are present.

Wellhead Protection Area - The area delineated around a wellhead (or production well) to be protected from possible sources/causes of groundwater contamination.

SUMMARY

SUMMARY

A. INTRODUCTION

The City and County of San Francisco (City) is proposing to implement two separate but related water management plans, a Recycled Water Master Plan (RWMP) and a Groundwater Master Plan (GWMP), under the auspices of the San Francisco Public Utilities Commission (PUC). As of August 1996, the PUC assumed jurisdiction over both the Clean Water Enterprise (responsible for wastewater management and formerly under the San Francisco Department of Public Works (DPW)) and the San Francisco Water Department (SFWD). The RWMP was prepared by the Clean Water Enterprise; the GWMP was prepared by SFWD. While the PUC is now the sponsor for both plans, this EIR continues to refer to DPW in association with the RWMP and to SFWD in association with the GWMP. The proposed plans have been developed to comply with San Francisco Ordinances 390-91 and 391-91, which mandated that the City develop a master plan to use groundwater and recycled water for maximum beneficial use wherever reasonable. Both plans include Citywide goals and policies for long-term management and use of the City's water resources as well as construction of new facilities at various locations throughout the City. The proposed construction projects consist of facilities needed for treatment, storage, extraction, distribution and use of these water resources.

This document is the Environmental Impact Report (EIR) on the RWMP and the GWMP, referred to collectively as the "proposed project," and has been prepared in compliance with the California Environmental Quality Act (CEQA). This summary section of the EIR, in compliance with CEQA Section 15123, provides a brief overview of the RWMP and GWMP and their potential physical environmental effects as determined in the EIR. The summary contains the following: (1) role of the EIR; (2) project descriptions of the RWMP and the GWMP; (3) summary of impacts of the RWMP and GWMP, first by site-specific components of each plan and then by overall and system-wide program of each plan separately and jointly; (4) summary of water supply and growth inducement effects; (5) summary of mitigation measures; (6) comparison of alternatives to the proposed project; (7) areas of controversy known to the City, including issues raised by responsible agencies and the public; and (8) issues to be resolved including the choice among alternatives and whether or how to mitigate the significant effects. More specific details on all aspects of the EIR, including figures showing details and location of the proposed project, follow in the full text of the report. Pages where the detailed information is

located are shown at the beginning of each subsection in the Summary to provide a "road map" to the document. A glossary and list of acronyms used in the report are provided immediately following the Table of Contents.

B. ROLE OF THE EIR

The San Francisco Planning Department, Office of Environmental Review has determined that the RWMP and GWMP are subject to the requirements of the CEQA and that an EIR on the two plans is required. The purpose of the EIR is to provide information about potential, significant physical environmental effects of the proposed project, to identify possible ways to minimize the significant effects, and to describe and analyze possible alternatives to the proposed project. This information is being made available to the City, other responsible agencies and the public as one part of the information decision makers will use in acting on the proposed project. The San Francisco City Planning Commission must certify the EIR as adequate and in compliance with CEQA before any City decision can be made on the plans. Following certification of the EIR, the RWMP and GWMP would be presented to the San Francisco Public Utilities Commission and the Board of Supervisors for a final decision as to adoption of the proposed plans.

This document is a joint EIR on both the RWMP and the GWMP. Both plans have long-term implications for the future management and use of water resources within the City, and in accordance with the requirements of CEQA, the environmental analysis of the overall plans is presented in this EIR at a "program-level" of analysis as part of a Program EIR. The program-level of analysis addresses the potential environmental consequences of the overall objectives and conceptual design of the plans while acknowledging the cumulative effects of the plans and individual plan components. Future individual activities which might be proposed pursuant to the plans, though not yet specified at this time, would be reviewed in the future relative to the program-level environmental analysis in this report and may or may not require subsequent environmental analysis, as determined by the City's Planning Department on a case-by-case basis.

In addition to the program-level analysis presented in this report, the EIR also addresses specific facility components of both the RWMP and the GWMP on a "project-level" of analysis. The potential environmental effects of these project components with more detailed design and siting information are evaluated in a more site-specific, detailed manner, including specific construction techniques, siting constraints and operation of the individual project component. The "project" aspects of this EIR are intended to fulfill all environmental review requirements

for these specific projects, and would permit implementation and construction of these project components without further environmental review, assuming EIR certification, plan adoption, and approval of these projects.

An overview of the project components contained in both the RWMP and GWMP is presented in Figure S-1, Project Description at a Glance.

C. PROJECT DESCRIPTION

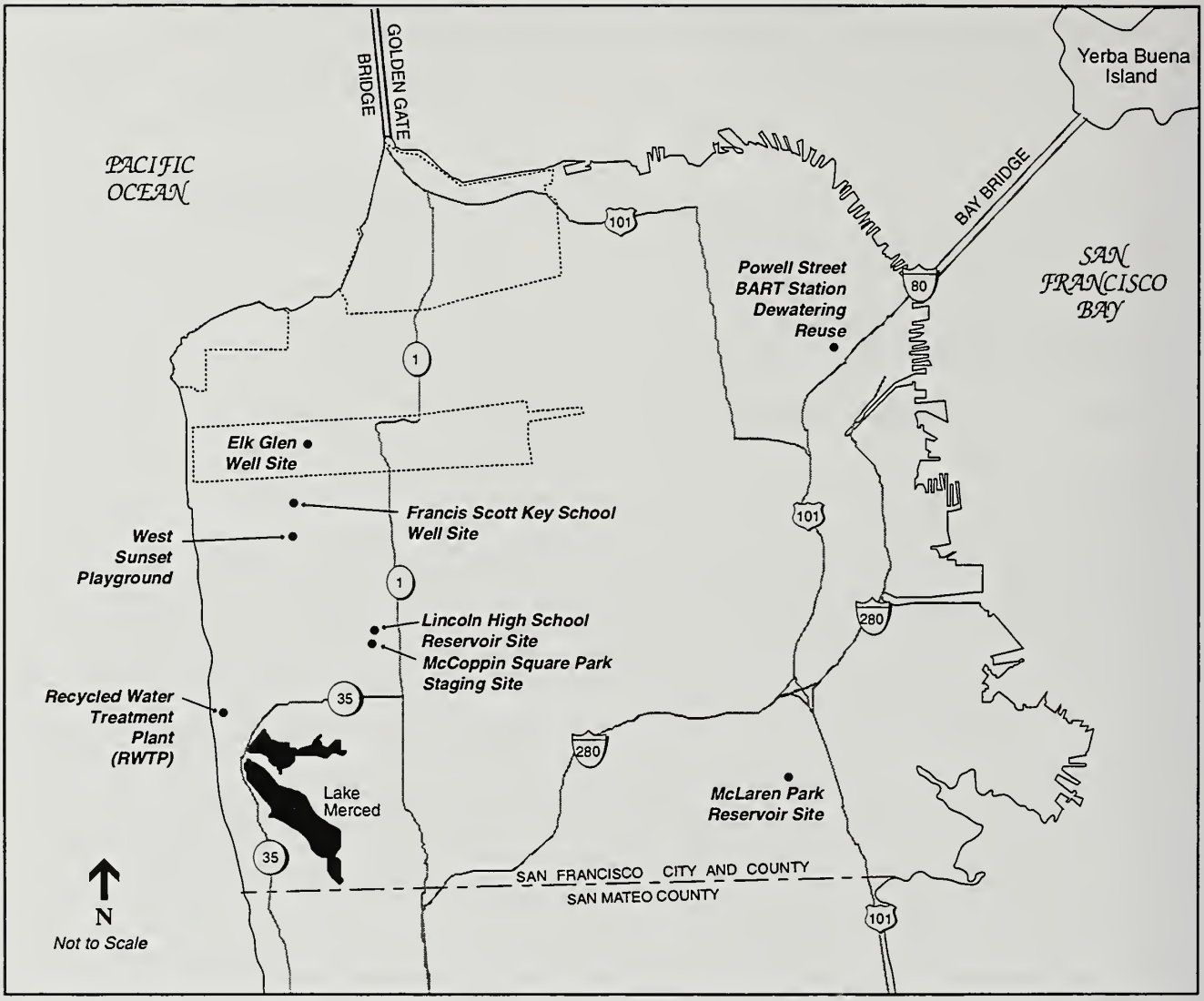
RECYCLED WATER MASTER PLAN (pp. 29 to 69)

Purpose

Recycled water, also known as reclaimed wastewater, is highly treated wastewater from the sewerage system that has undergone several levels of treatment so that it is acceptable for various non-potable uses. Non-potable water is water that is not intended for human consumption, but depending on the quality, it can be suitable for other uses, such as landscape irrigation, toilet flushing, and industrial cooling. Currently, the City is using high quality drinking water for a number of these non-potable uses. The RWMP presents the City's plans to develop and use recycled water for non-potable uses within the City so that high quality drinking water can be preserved for potable uses and at the same time improve the overall water supply reliability of the City, particularly during drought periods.

Overview

The RWMP includes the following: identification of categories of recycled water uses and potential users; projected recycled water demand and volume/flow requirements; water quality considerations for recycled water development and use; description of proposed facilities to be constructed; phased implementation program, project costs and funding considerations. The RWMP indicates that by the year 2010, there will be a potential, city-wide demand for non-potable water that can be supplied by recycled water of about 10.3 million gallons per day, on an average day, or approximately 11,500 acre-feet per year in an average year. The identified recycled water uses would be primarily for landscape irrigation (72%), toilet flushing and office cooling systems (20%), and industrial uses (8%), as shown in Figure 10, p. 35. The recycled water distribution system would be available to serve most of the City with the major exception of the downtown area, due to the constraints on the distribution system in this area.



RECYCLED WATER MASTER PLAN
Near-term Projects
Project-level analysis

- Recycled Water Treatment Plant - RWTP at Fleishhacker Pool Site / SF Zoo
- 2 Reservoirs:
  - Lincoln High School Site
  - McLaren Park Site (Alts. 1 and 2)
- McCoppin Square Park Construction Staging Area
- Transmission Pipelines from RWTP to reservoir at Lincoln High School

GOUNDWATER MASTER PLAN
Near-term Projects
Project-level analysis

- 1 well at Elk Glen, Golden Gate Park
- 2 Sunset District wells:
  - Francis Scott Key School
  - West Sunset Playground
- Pipelines for the 3 well projects
- Powell Street BART Station Dewatering

SOURCE: Clean Water Enterprise, 1996

SF RWMP/GWMP Program EIR ■

Figure S-1
Project Description at a Glance

The City's recycled water treatment system would be designed to comply with the most stringent water quality and public health standards, as listed in Title 22, Division 4 of the *California Code of Regulations.* Thus, the water quality of the recycled water would be considered acceptable to public health for landscape irrigation with high public contact and other non-potable uses with public contact. The design of the recycled water system would also account for water quality requirements of other potential users, such as fire fighting and industrial uses.

Proposed Facilities

Implementation of the RWMP would require construction of a recycled water treatment plant, two storage reservoirs, about 28 miles of new pipelines, two pump stations, and service connection vaults within the pipeline network, all at various locations throughout the City. The recycled water treatment plant would use treated wastewater from the Oceanside Water Pollution Control Plant and provide additional treatment so that the quality would meet regulatory requirements and user needs. The recycled water would be conveyed through transmission pipelines to two storage reservoirs serving different parts of the City, and distribution pipelines would transport recycled water to the various recycled water users throughout the City.

The transmission and distribution pipelines would be constructed to meet the standards of the existing Auxiliary Water Supply System (AWSS) pipelines which currently provides non-potable water for fire fighting. The existing water supply for the AWSS is primarily potable water from the SFWD, but because there is inadequate disinfection within the AWSS, the water at the AWSS hydrants is non-potable; in addition, saltwater from the Bay has been used as an alternate water supply for the AWSS. The proposed recycled water distribution system would serve a dual purpose in providing recycled water for fire protection as well as for other identified recycled water users. In some parts of the City, the recycled water distribution system would connect to the existing AWSS pipelines, and in other areas it would expand the fire fighting capabilities.

The RWMP would be implemented in three phases over approximately a 15-year period starting in 1997 and completed by 2012. Figure 12, p. 40 shows the proposed locations of the recycled water system facilities and the phasing program.

Phase 1 would include construction of the basic recycled water system facilities in the western part of the City, including the recycled water treatment plant (RWTP) which includes one pump station, one storage reservoir which includes a second pump station, transmission pipelines connecting the plant and the reservoir, and distribution pipelines from the reservoir to the users.

The proposed RWTP, including a pump station, would be located at the site of the former Fleishhacker Pool, adjacent to the San Francisco Zoo, at the Great Highway and Sloat Boulevard. It would include both above- and below-ground structures. The above ground structure would occupy only a portion of the site, about 25,000 square feet, with a maximum height of about 40 feet above the ground surface. The below ground structures would be a maximum depth of about 15 feet below grade.

The proposed reservoir for the west and southwest part of the City would be constructed at the Lincoln High School football field, at Santiago Street between 22nd and 24th avenues. This reservoir would have a capacity of 15 million gallons, would be constructed entirely below grade about 25 to 30 feet deep, and would include a second pump station. Following construction of the reservoir and pump station at Lincoln High School, the surface of the site would be restored to its current uses. Phase 1 is scheduled to be completed by 2001, and at that time, recycled water would be available to serve most of the westside users, such as Golden Gate Park, the Presidio, Lake Merced/Harding Park, and the Zoo.

Phase 2 construction is scheduled for completion in 2006 and would include construction of a storage reservoir at McLaren Park at one of two possible locations, both near John F. Shelley Drive. Site 1 is located adjacent to the existing Upper Reservoir at the existing parking lot and surrounding open space area; Site 2 is located on Mansell Street near John F. Shelley Drive in an open space grassy area with a series of ridges and swales. This reservoir, at either location, would have a capacity of 10 to 15 million gallons and be about 30 to 35 feet deep. It would be a buried structure similar to the other reservoir, with park uses restored above the reservoir following construction. The McLaren Park reservoir would serve the eastside of the City and could possibly be supplied with groundwater until the connection to the RWTP is completed in Phase 3.

Phase 3 would complete construction of the recycled water system and would include construction of the transmission pipelines from the RWTP to the reservoir at McLaren Park and from the reservoir to the users on the east side of the City. The specific pipeline route for this phase has not yet been identified. Upon completion of Phase 3 in 2012, recycled water would be available to serve users on the east side of the City, with the major users including the planned developments at Mission Bay and Hunters Point.

GROUNDWATER MASTER PLAN (pp. 70 to 111)

Overview

Seven groundwater basins occur either wholly or partially beneath the City and County of San Francisco (see Figure 20, p. 71). The GWMP contains the SFWD's plans to evaluate, manage, and develop these local groundwater resources for both potable and non-potable uses. Potential long-term groundwater users were identified in conjunction with the RWMP in terms of location of the users, water quality requirements, availability or accessibility of the water source, and cost-effectiveness.

The GWMP identifies five basic goals, as well as a variety of long-term strategies and short-term activities for the purpose of evaluating, managing and developing the City's groundwater resources.. As defined in the GWMP, *goals* are "the Water Department's ultimate purpose in managing, developing and using local groundwater"; *long-term strategies* are "management practices and techniques to guide activities to be implemented over the next 20 years toward meeting those goals"; and *short-term activities* are "specific activities to be conducted within the next five years to begin management, development, and use of groundwater. These include both constructible projects and program development, as well as additional studies to define subsequent activities."

The five basic goals of the GWMP are to: Protect and Enhance Groundwater Quality; Coordinate Groundwater Use; Protect and Conserve Related Water Resources; Improve Ability to Deliver Water During Emergencies; and Maximize Groundwater Use. Summary tables of these goals, as well as the underlying strategies and activities to implement these goals, are presented in Figures 21 and 22, pp. 72 and 73.

There are a few specific short-term activities proposed as part of the GWMP, described below. Most of the GWMP goals, strategies and activities, however, reflect the fact that more investigation and data collection are required before more specific projects can be proposed. Based on the data available to date, the GWMP indicates that the Westside Basin has the greatest potential for adding potable water to the City's overall water supply. The Westside Basin is a large groundwater basin which extends from the Presidio to south of the county line, and underlies much of northern San Mateo County as well as the westside of San Francisco. Many of the short-term activities outlined in the GWMP are focused on the Westside Basin.

Proposed Projects

The GWMP includes two specific short-term activities to extract potable groundwater from the northern portion of the Westside Basin and to add that water to the City's potable water distribution system. One proposed project is the rehabilitation of the existing Elk Glen Well in Golden Gate Park, and the second project is the construction of two production wells proposed in the Sunset District (see Figure 30, p. 98). The two identified sites for the Sunset District wells are: the parking lot at the West Sunset Playground at 41st Avenue and Quintara Street and the playground at Frances Scott Key School at 42nd Avenue and Kirkham Street.

In addition to the production well and associated pumps, construction and development of these wells would include on-site chlorination system and pipelines to connect the wells to the existing potable water main distribution system. Concurrent with the installation of these production wells, it is proposed that saltwater intrusion modeling be refined and that saltwater intrusion monitoring wells be installed. In total, the Elk Glen and Sunset District wells would be expected to yield about 1,300 to 1,800 acre-feet of water per year (1.2 to 1.6 million gallons daily) to the City's water supply system, but the rate of pumping would be monitored to assure that saltwater intrusion does not occur in the groundwater basin.

Another proposed short-term activity is to capture groundwater that is currently being pumped from the Powell Street BART Station and to add that water to the AWSS. This project would consist of installation of pumping and injection equipment within the BART station and piping to the AWSS on Powell Street at Market. About 150 acre-feet of groundwater per year is expected to be injected to the AWSS from the BART station dewatering facility.

The GWMP also outlines a proposal to implement in the near future an "in-lieu" groundwater recharge program for the southern portion of the Westside Basin. The program would involve coordination of groundwater users in southwestern San Francisco, Daly City, San Bruno, and those served by California Water Service Company. This program would involve the coordinated management of groundwater and surface water supplies to increase the overall availability of water during droughts or other periods of need. Although a specific program has not yet been outlined nor have specific facility projects been identified, one program being considered is for SFWD to supply surface water from its Hetch Hetchy/Bay area watershed system to groundwater pumpers in the southern portion of the Westside Basin during periods when surplus surface water is available. In exchange, the groundwater users would reduce or cease groundwater pumping during these periods. This would allow the aquifer to recharge. The

water accumulated in the groundwater aquifer could then be withdrawn by the pumpers during periods of surface water supply shortages in lieu of (instead of) purchasing a like amount of surface water from SFWD. The "in lieu" recharge program in the southern Westside Basin would relieve reported overdraft conditions (excessive groundwater pumping) in the aquifer, and since Lake Merced is connected to the groundwater system, the recharge program would also offset declining water levels in Lake Merced.

D. SUMMARY OF POTENTIAL IMPACTS

INTRODUCTION

The potential impacts associated with implementation of the proposed project are summarized below, first for the RWMP and then for the GWMP. The EIR presents the detailed impact analysis by topics, and both program-level and project-level impacts to the overall system or of individual project sites are discussed under each topic. This summary of impacts, however, is organized by project site or overall system, rather than by topic, to assist the reader in locating any impacts of interest at a specific location. In addition, the impacts are described with the assumption that mitigation measures incorporated into the proposed project would be implemented.

All potential impacts discussed in the EIR are also summarized in tabular form to assist the reader in understanding the various program level and project level aspects of each plan. The inclusion of an impact on the tables does not imply the significance of the impact, only that it is discussed in the EIR. The RWMP impacts are summarized in Table S-1 (beginning on p. S-23), while the GWMP impacts are summarized in two tables according to management/use impacts and project impacts, Tables S-2 and S-3 (beginning on p. S-41 and p. S-44, respectively). The tables follow immediately after the summary text description of impacts of each plan. The tables are organized by topic and indicate to which facility site or project component the impacts apply. They can also serve as an index to the impacts and mitigation measures discussed in the EIR, since they indicate the page numbers in the main body of the EIR where the impacts (I) and mitigation measures (M) are discussed in more detail.

RECYCLED WATER MASTER PLAN

Facilities and Project Sites

Recycled Water Treatment Plant - Fleishhacker Site

The Fleishhacker RWTP site is zoned "P"-- Public Use District. Construction of the RWTP facilities on the site would permanently convert a currently unused portion of this area to a public utility use, and use of the site would require approval by the San Francisco Recreation and Park Department. The majority of the RWTP facilities would be constructed below-ground and would be designed to accommodate joint use with other uses. The design of the above-ground RWTP facilities would be coordinated with the Zoological Gardens in order to ensure land use and visual compatibility with the Zoo's uses on the site.

Construction staging for the recycled water facilities would temporarily displace existing land uses on about half of the paved Fleishhacker Pool and Bath House area for about 24 months. However, the displaced uses, namely Zoo employee parking, Zoo materials storage, and staging activities for Zoo projects, could most likely be consolidated and accommodated on the remaining southern portion of the Fleishhacker Pool area.

Construction dewatering at the RWTP site could affect Zoo wells, promote saltwater intrusion, and/or accelerate migration of contaminated groundwater present beneath a former service station on Sloat Boulevard. Although the service station site has been remediated in accordance with RWQCB requirements and is now under construction with residential uses, some residual contaminants remain in the groundwater. The City would therefore monitor groundwater during dewatering. Construction dewatering may also temporarily increase flow to the sewer system.

Erosion control measures would be implemented to minimize the potential for erosion impacts at the site due to construction excavation and earthmoving activities. This site is in an area of potential liquefaction (due to sandy substrate and fill). A site-specific geotechnical investigation including subsurface borings would be required to determine the presence and extent of the any geotechnical hazards and to develop appropriate control measures.

In addition, hazardous wastes may be encountered at the RWTP site in the soils from debris in the former pool or in the groundwater from an adjacent former service station. Sampling would be required. Hazardous building materials present in the Fleishhacker Bath House would be

removed prior to demolition to eliminate any potential for worker or public exposure to hazardous materials.

Temporary construction-generated traffic would interact with, and could cause intermittent delays to other vehicular traffic in the RWTP vicinity, including public transit. Traffic control and safety measures would be employed to minimize the effects of construction on local traffic.

Construction activities could also result in PM_{10} levels exceeding state (but not federal) standards, as well as temporary noise and vibration increases in the area. Construction dust, noise and vibration could adversely affect Zoo animals located 150 to 200 feet east of the construction area, and possibly future residents if the recently completed residential project on the parcel to the north is occupied prior to project construction. Dust control, and noise and vibration attenuation strategies would be employed to minimize these impacts. In addition, behavior of adjacent Zoo animals would be monitored during construction to verify that mitigation measures are adequate to prevent disturbance of animals. In the event that native rock containing asbestos is encountered during excavation, dust control, sampling and monitoring would be conducted to prevent potential public health impacts.

Simultaneous construction of RWMP projects and Zoo projects could increase the ambient dust and the frequency of noise peaks in the adjacent areas. However, most Zoo projects in the vicinity of the RWTP site are scheduled to be completed prior to RWTP construction.

Construction of the RWTP at the Fleishhacker site would involve demolition of the Fleishhacker Bath House, which is not considered eligible for the National Register of Historic Places. Demolition of this structure has previously been approved for other projects.

Operation of the RWTP would involve the handling of chemicals which are considered hazardous, but handling and storage of chemicals would comply with applicable regulations. Operation of facilities (pumps or air blowers) at the RWTP site could also result in noise increases above existing ambient noise levels and would require provision of noise attenuation measures.

Storage Reservoirs

Lincoln High School Reservoir Site / McCoppin Park Staging Area. The Lincoln High School reservoir site is zoned "P" -- Public Use District. Construction of the below ground

reservoir on the site would allow joint use of this area for a public utility use and continuing public school uses. Use of the site would require approval by the San Francisco Unified School District. The reservoir would be below-ground and would be designed to accommodate joint use with existing school uses during long-term operation of the reservoir. Construction of a reservoir at the Lincoln High School site would temporarily displace the existing uses of the site, including football, track, and school assembly during the eight-month construction period. The DPW would work with the School District to find alternative interim sites for displaced school sports activities (including possibly improving areas for use elsewhere on school grounds to the extent feasible), and to design and construct a replacement stadium upon completion of reservoir construction. McCoppin Park is the proposed staging area during reservoir construction at the Lincoln site, and use of the site would require approval by the San Francisco Recreation and Park Department. Construction staging at the north end of McCoppin Park would temporarily restrict use of the perimeter of the park but the playfield would not be disrupted.

Construction activities would also temporarily alter the visual character of the reservoir site and of the McCoppin Square Park staging area. However, the completed reservoir would be below-ground, and the site and staging area would be restored to pre-construction conditions or better.

Construction dewatering may be required at the Lincoln reservoir site, but would not likely affect any nearby wells since the nearest well is in Stern Grove about 4 to 5 blocks south of the site. The City would monitor groundwater at nearby wells if dewatering is necessary.

Erosion control measures would be implemented to minimize the potential for erosion impacts at the site due to construction excavation and earthmoving activities. Although there are no known or apparent geologic hazards, no subsurface investigation has yet been conducted at this site. Potential geologic constraints or hazards (such as liquefaction due to sandy substrate or prior fill) could occur. Prior to construction, a site-specific geotechnical investigation would be conducted including subsurface borings to determine the presence and extent of any potential geologic hazard and to develop appropriate control measures. A site investigation including soil sampling would be conducted at the Lincoln site to determine if previous land uses have left subsurface hazardous materials which could be disturbed during construction.

Temporary construction-generated traffic would interact with, and could cause intermittent delays to other vehicular traffic in the reservoir vicinity, including public transit. The temporary closure of two blocks of Santiago Street for construction staging would alter the local traffic

circulation pattern. Traffic control and safety measures would be employed to minimize the effects of construction on local traffic.

Construction activities could also result in PM_{10} levels exceeding state (but not federal) standards, as well as temporary noise and vibration increases in the area. Construction dust, noise and vibration could adversely affect adjacent school uses, park uses, and residents immediately across 22nd Avenue from the construction site. Dust control, and noise and vibration attenuation strategies would be employed to minimize these impacts. In the event that native rock containing asbestos is encountered during excavation, dust control, sampling and monitoring would be conducted to prevent potential public health impacts.

Up to 10 mature acacia, Monterey pine and cypress trees could be removed from the Lincoln site, and up to 13 mature trees could be affected by construction staging at the McCoppin Park staging area. Measures would be employed to protect McCoppin Park vegetation from impacts of staging, and the DPW would work with the School District and the Recreation and Park Department to design revegetation plans for any impacted or removed vegetation at the school and/or park. While no Monarch butterflies have been observed using the trees on this site, these trees are the type the butterfly uses for overwintering. It is unlikely that these trees serve as roosting sites for the butterfly due to the amount of human disturbance presently occurring around these trees. Butterfly surveys would be conducted during the winter season prior to construction to determine if the Monarch butterfly has commenced to use trees on the site, where and to what extent. If the butterfly is present, mitigation measures, such as restricting the period of construction until after the overwintering period, would be implemented.

Operation of pumps at the Lincoln reservoir site could result in noise increases above existing ambient noise levels and would require provision of noise attenuation measures.

McLaren Park Site 1. McLaren Park reservoir Site 1 is zoned "P"-- Public Use District. Construction of the underground reservoir on the site would allow joint use of this site for both a public utility use and continuing public park use on the surface, (although some surface uses would be restricted over the reservoir, such as structures). The Rec Park Commission must make a determination of whether the proposed reservoir is consistent with the City park uses. In the event the Commission determines it is not, the City Charter requires a public vote on the proposed use. The reservoir would be constructed below-ground, and during long-term operation of the reservoir, the site would accommodate joint use with other park uses. Construction of a reservoir at McLaren Park Site 1 would temporarily displace the existing uses of the site,

including recreational use (jogging, dog walking) on the on-site park paths, and parking in the Upper Reservoir parking lot. The DPW would work with the Recreation and Park Department to design plans for restoration and improvement of the site.

Construction activities would also alter the visual character of the reservoir site during the 12-month construction period. However, the completed reservoir would be below-ground and the site would be restored to pre-construction conditions or better.

Erosion control measures would be implemented to minimize the potential for erosion impacts at the site due to construction excavation and earthmoving activities. Although there are no known or apparent geologic hazards or constraints, the project site is located in hill terrain and no subsurface investigation has yet been conducted. Prior to construction of the reservoir, a site-specific geotechnical investigation, including subsurface borings, would be conducted to determine the presence and extent of any geologic constraint or hazard, such as liquefaction or slope stability issues, and to determine appropriate design and control measures.

Construction traffic would temporarily increase the traffic on local roads. The closure of a portion of John F. Shelly Drive above the Upper Reservoir during construction would temporarily alter local traffic circulation patterns and reduce ease of access to portions of the park. Traffic control and safety measures would be employed to minimize the effects of construction on local traffic.

Construction activities could result in PM_{10} levels approaching state standards at residences located 250 feet west of the site; the residences' upwind location would help minimize potential adverse effects. Construction could also cause temporary noise and vibration increases in the area. Dust control, and noise and vibration attenuation strategies would be employed to minimize these impacts. In the event that native rock containing asbestos is encountered during excavation, dust control, sampling and monitoring would be conducted to prevent potential public health impacts.

During construction, visual disruption, access reduction, dust, noise, and vibration would be noticeable to park users in the vicinity of the site, and would most likely temporarily displace park visitors from the Upper Reservoir area to other sites in the park during the construction period.

Construction of the reservoir at McLaren Site 1 would disturb approximately 1.5 acres of non-native grassland in addition to temporary removal of the parking lot and a portion of the roadway area. It would necessitate the removal of approximately 15 Monterey cypress and pine trees. The DPW would work with the Recreation and Park Department to design revegetation plans for any removed or disturbed vegetation at the park and to restore park uses following completion of reservoir construction. While no Monarch butterflies have been observed using the trees at this site, these trees are the type the butterfly uses for overwintering. It is unlikely that these trees serve as roosting sites for the butterfly due to the amount of human disturbance and wind exposure presently occurring around these trees. Butterfly surveys would be conducted during the winter season prior to construction to determine if the Monarch butterfly has commenced to use trees on the site, where and to what extent. If the butterfly is present, mitigation such as restricting the construction season until after the overwintering period would be implemented.

Site 1 is considered environmentally superior to Site 2, since it would involve less disturbance of open space, native grassland, habitat area and natural drainage contours, as described below.

McLaren Park Site 2. McLaren Park reservoir Site 2 is also zoned a "P" -- Public Use District. Construction of the underground reservoir on the site would allow joint use of the site for both the proposed public utility use and continuing public park uses on the surface. The Rec Park Commission must make a determination of whether the proposed reservoir is consistent with the City park uses. In the event the Commission determines it is not, the City Charter requires a public vote on the proposed use. As with the other reservoir sites, the reservoir would be constructed below-ground, and during long-term operation of the reservoir, the site would be designed to accommodate joint use with other park uses. Construction of a reservoir at McLaren Park Site 2 would temporarily displace the existing uses of the site, including recreational use (jogging, dog walking, nature viewing) on the park paths which traverse the site. The DPW would work with the Recreation and Park Department to design plans for restoration and improvement of the park site.

Construction activities would also alter the visual character of the reservoir site during the 12-month construction period. However, the completed reservoir would be below-ground and the site would be restored to pre-construction conditions or better.

Erosion control measures would be implemented to minimize the potential for erosion impacts at the site due to construction excavation and earthmoving activities. Although there are no known or apparent geologic hazards or constraints, the project site is located in hill terrain and no

subsurface investigation has yet been conducted. Prior to construction of the reservoir, site-specific geotechnical investigation would be conducted, including subsurface borings, to determine the presence and extent of any geologic constraint or hazard, such as liquefaction or slope stability issues, and to determine appropriate design and control measures.

Construction traffic would temporarily increase the traffic on local roads. Closure of a portion of John F. Shelly Drive near the intersection with Mansell Street during construction would temporarily alter the local traffic circulation pattern and reduce ease of access to portions of the park. Traffic control and safety measures would be employed to minimize the effects of construction on local traffic.

Because of the site's distance from sensitive receptors such as residences and homes, dust, noise and vibration impacts of construction are not expected to violate any standards. However, construction activity would be noticeable to park users and would most likely displace park visitors from the Site 2 area to other sites in the park during the construction period. Dust control, and noise and vibration attenuation strategies would be employed to minimize these impacts. In the event that native rock containing asbestos is encountered during excavation, dust control, sampling and monitoring would be conducted to prevent potential public health impacts.

Construction of the divided reservoir at McLaren Park Site 2 would results in the temporary loss of approximately 4 acres of grassland, including some native species. Up to 23 mature trees, a mix of Monterey pine and cypress and eucalyptus, could be removed or damaged in the construction process. While no Monarch butterflies have been observed using the trees at this site, these trees are the type the butterfly uses for overwintering. It is unlikely that these trees serve as roosting sites for the butterfly due to the amount of human disturbance and wind exposure presently occurring around these trees. Butterfly surveys would be conducted during the winter season prior to construction to determine if the Monarch butterfly has commenced to use trees on the site, where and to what extent. If the butterfly is present, mitigation such as restricting the construction season until after the overwintering period would be implemented. Downslope of the site, within 25 to 80 feet north and northwest, is a dense woodland of Monterey pines, cypress and eucalyptus as well as an arroyo willow thicket; although construction would not disturb these areas, wildlife use of these areas would likely be disrupted during the 12-month construction period.

The site is located upslope of a natural topographic drainage area which supports a dense woodland and willow thicket area. Construction of the buried reservoir would alter the

topography of the hill. Drainage patterns would be modified but surface runoff from the site would continue to drain into the draw. Surface drainage modifications are not expected to result in adverse impacts to downslope vegetation within the drainage area.

However, there is a reported spring within the densely vegetated area approximately 30 feet northeast and 40 to 500 feet downslope from the reservoir site. Reservoir construction would not directly affect this area, but indirectly, installation of the reservoir 30 feet below ground could modify subsurface drainage flows and affect spring flow. Given the distance between the reservoir and the reported spring location, the project would not be expected to affect such downslope springs. On-site geotechnical investigations would determine if the spring would be affected and if control measures would be required.

Transmission and Distribution Pipelines

Transmission and distribution pipelines would generally be located within roadway rights-of-way, and specific routing of most pipelines would be determined during the pre-design phase of the project. However, the routing of the transmission pipeline connecting the RWTP and the reservoir site at Lincoln High School has been identified and is discussed below. Pipelines would range in size from 8 to 24 inches in diameter, and maximum depth of trenches for pipeline installation would be six feet. Installation of pipelines would generally be done using open cut methods.

Construction of some pipelines could require dewatering along some portions of routes, and could temporarily affect flow of shallow groundwater. Pipeline construction activities and heavy equipment use in city streets could also temporarily disrupt existing transportation and circulation patterns in the vicinity of the proposed pipeline alignments. Temporary lane blockages or street closures, when required during pipeline installation, would result in a reduction in travel lanes and curb parking, and could result in the need for traffic re-routing. Public transit routes, pedestrian and bicycle traffic and access to businesses and residences could also be disrupted at times during construction. Traffic control and safety measures would be employed to minimize the effects of construction on local traffic.

Construction activities could result in PM_{10} levels exceeding state (but not federal) standards, adversely affecting residents living along pipeline routes. Construction activities could cause temporary noise and vibration increases which could also disturb adjacent residential uses along pipeline routes. Dust control, and noise and vibration attenuation strategies would be employed

to minimize these impacts. In the event that native rock containing asbestos is encountered during excavation, dust control, sampling and monitoring would be conducted to prevent potential public health impacts, but this is not expected since the maximum trench depth would be six feet.

Transmission Pipelines from the RWTP to Lincoln Reservoir. The alignment of the transmission pipelines to connect the RWTP and the reservoir at the Lincoln High School site has been identified (see Figure 12, p. 40), and these pipelines would be constructed as part of Phase 1 implementation of the RWMP.

Construction of the transmission pipeline between the Fleishhacker RWTP site and the Lincoln High School reservoir site could require dewatering along some portions of the route, and could temporarily affect shallow groundwater movement in the vicinity. Pipeline construction activities and heavy equipment use in city streets could also temporarily disrupt existing transportation and circulation patterns in the vicinity of the proposed pipeline alignments. Temporary lane blockages or street closures, when required during pipeline installation, would result in a reduction in travel lanes and curb parking, and could result in the need for traffic re-routing. Public transit routes, and pedestrian and bicycle traffic also would be disrupted during construction. In addition, access to businesses along Sloat Boulevard (and a few along Santiago) and residences would be disrupted. Traffic control and safety measures would be employed to minimize the effects of construction on local traffic.

Construction activities could result in PM_{10} levels exceeding state (but not federal) standards, adversely affecting residents living along pipeline routes. Construction activities could cause temporary noise and vibration increases which could also disturb adjacent residential uses along pipeline routes. Dust control, and noise and vibration attenuation strategies would be employed to minimize these impacts. In the event that native rock containing asbestos is encountered during excavation, dust control, sampling and monitoring would be conducted to prevent potential public health impacts, but this is not expected since the maximum trench depth would be six feet.

Effects of Using Recycled Water

Water Quality and Public Health

Potential effects and acceptability of using recycled water relate primarily to its water quality. The projected quality of the recycled water is based on the quality of the wastewater supply source and the recycled water treatment process. The wastewater supply would be secondary effluent (wastewater that has undergone physical and biological oxidation treatment) from the Oceanside Water Pollution Control Plant. The recycled water treatment process would consist of disinfection and direct filtration. The proposed recycled water treatment processes would be designed to produce the highest level of recycled water quality, as defined in the wastewater reclamation criteria in Title 22 of the *California Code of Regulations*, and the recycled water would be considered acceptable for unrestricted non-potable uses. The California Department of Health Services has determined that compliance with these criteria and the proposed level of treatment provide a high degree of public health protection for non-potable uses, including uses with high public contact.

In addition to meeting Title 22 wastewater reclamation criteria, the RWMP would be subject to Water Reuse Requirements of the California Regional Water Quality Control Board. These requirements are established to provide design measures and operational procedures for protection of water quality and public health. The requirements would include specifications for treatment plant reliability, monitoring program, and contingency plan. It would also include specific requirements to prevent contamination of the potable water supply through any cross-connections with the recycled water system, as also required under Title 17 of the *California Code of Regulations*. Thus, the proposed RWMP would provide adequate safeguards for treatment plant effectiveness and system reliability to assure compliance with state regulations for wastewater reclamation. The overall recycled water system would provide a high degree of public health protection for the proposed non-potable uses of landscape irrigation, fire protection, commercial/office and industrial uses.

Landscape Irrigation Uses

The effects of irrigation with recycled water on landscape plants depends on the quality of the recycled water, sensitivity of the plant materials to the water quality, soil and drainage characteristics, and irrigation management practices. Based on general guidelines for suitability of recycled water for irrigation, the projected quality of the recycled water appears acceptable for most chemical constituents of concern, although it could be in the marginal range for some

constituents such as sodium and chloride, and certain plants may have specific sensitivities to these chemicals. Site-specific testing of recycled water irrigation on typical plants at Golden Gate Park has indicated that there were no discernible differences between plants irrigated with recycled water and those irrigated with potable water. Use of recycled water would provide additional nutrients to plants due to higher levels of nitrogen, phosphorus and potassium in the water and may reduce the fertilization needs at landscape irrigation sites. The DPW would coordinate with landscape managers so that they can make appropriate adjustments in irrigation and fertilization practices due to differences in water quality.

Use of recycled water for irrigation may result in leaching of some constituent in the recycled water to the groundwater. The primary constituent of concern would be nitrate, since it is regulated under primary drinking water standards. Nitrate is also a major plant nutrient and is commonly applied as fertilizer to landscape irrigation areas. Proper management of irrigation with recycled water would balance the nitrate application with plant nutrient needs and would minimize potential effects on groundwater.

Use of recycled water for irrigation would also reduce the demand for groundwater currently used to meet these demands. In particular, Golden Gate Park, the areas near Lake Merced, and the Presidio could use recycled water for irrigation rather than groundwater. Groundwater in these areas could then be reserved for potable uses or for emergency situations. By increasing the reliability of the City's water supply, the RWMP would make more water available for irrigation uses, particularly during drought periods.

Industrial and Commercial Uses

Typical industrial uses of recycled water would be for cooling, processing, boiler feeding and washing, and the predominant industrial use expected in San Francisco would be for cooling. Commercial uses could include air conditioning, cooling systems and toilet flushing. Water quality requirements of recycled water for any of specific uses in these categories would depend on the specific application of recycled water. The projected quality of the recycled water system is anticipated to be generally acceptable for users in these categories, although industry-specific water quality needs may require additional on-site treatment of the recycled water such salt removal or pH adjustment. A back-up water supply system for these users could also be required.

Commercial and office users of recycled water would not be expected to have specific water quality requirements, other than public health requirements discussed above under Water Quality and Public Health. Required signage and color-coding of piping would minimize public health exposure. To reduce potential corrosive effects of recycled water on pipelines, the recycled water treatment processes would include pH adjustment in addition to those required under Title 22 wastewater reclamation criteria.

System-wide/Operational Effects

Fire System Operation

The recycled water distribution system would be constructed to the standards of the AWSS pipelines, which is a high pressure water system that currently provides non-potable water for fire fighting in some parts of the City. Under the RWMP, the recycled water distribution system would be designed for joint use as a distribution system for recycled water users and as a fire protection water supply system. The RWMP proposes to use some of the existing AWSS pipelines plus construct new pipelines that would expand the fire protection capabilities (see Figure 12, p. 40). The RWMP would be developed in close coordination with the San Francisco Fire Department in order to maintain the overall reliability of the AWSS as a fire protection system. The recycled water distribution system would incorporate specific design guidelines for this purpose, including emergency back-up storage volume in the storage reservoirs designated solely for fire protection. As requested by the Fire Department, the recycled water system would not be connected to the AWSS in the downtown area where the potential emergency water demand during a fire is high and where the AWSS is older. The system would be designed so that all connections to the existing AWSS would be under direct control of the San Francisco Fire Department and the number of connections to the existing system would be minimized. Overall, the RWMP would expand the fire protection capabilities of the AWSS, provide additional water supply back-up storage, and would not compromise the reliability of the existing AWSS.

Water System Operation

The recycled water system would be physically isolated from the existing potable water supply system so that there could be no cross-connection and mixing of recycled and potable water. No disruption of the potable water system would be expected during construction or operation of the recycled water system. Implementation of the RWMP would provide recycled water for non-potable uses currently using potable water, and the availability of recycled water would increase

the diversity and reliability of San Francisco's potable water system. The effects of the RWMP on increased water supply are discussed below under *Water Supply Effects and Growth Inducement Potential.*

Wastewater System Operation

Currently, wastewater effluent from the Oceanside Water Pollution Control Plant is discharged to the Pacific Ocean through the Southwest Ocean Outfall. Production of recycled water would divert a portion of this wastewater from the ocean outfall to the Fleishhacker RWTP. During peak recycled water demand in the summer, the diversion could be as much as 100 percent and the hydraulic operation of the outfall could be affected. On-going studies to determine the effects of zero or low flow to the outfall are currently underway, independent of the proposed project, and results of that study would determine what if any effects would be anticipated and if corrective actions would be necessary. Diversion of effluent from the outfall is not expected to affect the quality of the remaining effluent discharged through the outfall.

Energy

The operational energy demands of the City's overall water supply system would be higher than current demands due to the addition of new facilities and development of the recycled water system under the proposed project. It is estimated that the proposed recycled water system would result in an additional energy demand of 14.7 million kilowatt-hours (kWh) per year. This potential demand is equal to approximately 0.1% of the total annual electricity demand in 1980 by all users in the City and County of San Francisco. The project-related increase in energy demand would be partially offset by the energy saved from reduced pumping of groundwater by recycled water users that are currently using groundwater. Current groundwater pumping requirements at Golden Gate Park are roughly estimated at 7.5 to 8.5 million kWh per year.

TABLE S-1: SUMMARY OF RWMP IMPACTS DISCUSSED IN EIR

IMPACTS	NEAR-TERM FACILITIES PROJECTS						OPERATION		FUTURE PROJECTS
	RWTP and PS	RESERVOIRS							
	Fleishhacker Pool	Lincoln HS and PS	McLaren Park #1	McLaren Park #2	McCoppin Park Staging /1/	Transmission Pipes	RW System Operation	Recycled Water Use	Distribution Pipelines
Land Use and Visual									
The RWMP project sites are on City property, either public parks or school. Construction of the recycled water system would permanently install a utility facility at these locations. However, the majority of the facilities at each site would be below-ground and would accommodate joint use with other existing and planned uses.	I: pp.251-255	I: pp.255-257	I: pp.257-259	I: pp.257-259					
Construction of the recycled water facilities would temporarily displace existing land uses on each site: RWTP site, 24 months: employee parking, Zoo project staging; Lincoln reservoir, 8 months: football/track field; McCoppin Park, 8 months: perimeter open space area; McLaren Park, 12 months, Site 1: open space, parking; Site 2: open space. Most noticeable displacement at the Lincoln reservoir site, due to the difficulty of finding equivalent nearby replacement sites for current on-site activities.	I: pp.251-253 M: #A-1, A-2	I: pp.255-256 M: #A-1, A-2	I: pp.257-259 M: #A-1, A-2	I: pp.258-259 M: #A-1, A-2	I: p.256 M: #A-1, A-2				
During construction, construction activities would be visible to the public and would result in temporary increases in noise, dust and truck traffic, temporarily disrupting adjacent land uses.	I: pp.254-255	I: p.257	I: p.259	I: p.259	I: p.257	I: pp.259-260			

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Groundwater and Surface Water Resources									
Application of recycled water to landscape areas at rates exceeding the irrigation requirements could potentially result in leaching of constituents in the recycled water to the groundwater. Monitoring of recycled water quality and coordination with users would minimize these effects.								I: pp.261-265 M: #B-7	
Use of recycled water for irrigation and other uses would reduce the demand for groundwater currently used to meet these demands, mostly affecting Golden Gate Park, Lake Merced and Presidio areas.								I: pp.265-267	
Use of recycled water for spray irrigation could result in runoff entering surface waters and promoting unwanted algal growth, but compliance with RWQCB requirements would minimize these effects.								I: pp.267-268 M: #B-6	
Construction dewatering at the RWTP site could affect Zoo wells and could promote saltwater intrusion. Monitoring would be required.	I: pp.268-271 M: #B-3, B-4, B-5								
Construction dewatering might be required at the Lincoln reservoir site and along the pipeline routes that could affect any nearby wells. Monitoring would be required.		I: p.271 M: #B-3, B-4, B-5				I: pp.271-272			

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Public Health and Water Quality									
Improper treatment and/or use of recycled water could result in public health impacts. Public could be exposed to aerosols during spray irrigation or during fire fighting. Given the strict treatment requirements, and the regulation and monitoring of use required, no adverse public health impacts are expected (none have occurred to date in similar programs).								I: pp.273-288 M: #C-3 C-4, C-5, C-7, C-8, C-9, C-10	
The potential for cross connection between the potable and recycled water systems would be minimized by compliance with Title 17 of the *California Code of Regulations*. The current fire-fighting water system allows some possibility, though limited, for cross-connection. Under review of DOHS, the City is currently implementing a Cross Control Plan for Fire Fighting Operations.						I: pp.283-285			I: pp.283-285
Although the quality of recycled water would be suitable for most industrial uses, some industries might require additional treatment and/or back-up water supplies.								I: pp.288-290 M: #C-6, C-11	
The quality of recycled water could result in corrosion of pipelines, although pH adjustment would be included in the project to minimize this effect.						I: pp.291-292		I: pp.291-292	I: pp.291-292

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Public Services and Utilities									
Construction of pipelines could result in temporary disruption of other utilities with service lines along the same corridor.						I: p.293 M: #D-1			I: p.293
The recycled water system would increase the water supply reliability of the AWSS and also extend the fire protection capabilities of the AWSS.							I: pp.294-297		
Construction dewatering could temporarily increase flow to the sewer system.	I: p.297	I: p.297							
Production and use of recycled water would reduce the flow of effluent through the Southwest Ocean Outfall, but the quality of the effluent would not change appreciably.							I: p.298-299 M: #D-2		
Geology, Soils and Seismicity									
Excavation and earthmoving activities during construction at all sites could result in excess erosion to the sewer system if adequate controls are not implemented.	I: p.300 M: #E-5	I: p.300 M: #E-5	I: p.300 M: #E-5	I: p.300 M: #E-5					
There is a potential for slope instability during excavation at some project sites.		I: p.301 M: #E-1, E-7, E-8	I: p.301 M: #E-1, E-7, E-8	I: p.301 M: #E-1 E-7, E-8					

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There are seismic-related hazards at all sites which could result in varying degrees of structural damage during an earthquake, but damage could be minimized by employing appropriate geotechnical and structural design measures.	I: pp.301-303 M: #E-1, E-2, E-6	I: pp.301-303 M: #E-1, E-2	I: pp.301-303 M: #E-1, E-2	I: pp.301-303 M: #E-1, E-2		I: pp.301-303 M: #E-2			I: pp.301-303 M: #E-2
There is a potential liquefaction hazard that could result in differential settlement and structural damage in the event of an earthquake, but damage could be minimized by employing appropriate geotechnical and structural design measures	I: pp.302-303 M: #E-6					I: pp.302-303			
The presence of mixed rock type of bedrock or unsuitable soils for bearing support could result in differential settlement and structural damage but could be minimized by appropriate design measures.		I: pp.303-304 M: #E-1, E-7	I: pp.303-304 M: #E-1, E-7	I: pp.303-304 M: #E-1, E-7					
Potential hazards associated with excavation include settlement of adjacent structures, which could be prevented with appropriate measures determined by geotechnical studies.		I: pp.304-305 M: #E-7							
At all sites, there is the potential to encounter serpentine rock, which contains naturally-occurring asbestos, and could present a public health concern unless appropriate monitoring and control measures are employed.	I: p.305 M: #H-3, F-10	I: p.305 M: #H-3, F-10	I: p.305 M: #H-3, F-10	I: p.305 M: #H-3, F-10					

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Hazardous Materials									
At all sites, there is low potential to encounter hazardous wastes in the soils or groundwater from previous land uses, but updated review of regulatory agency listings would be conducted and contingency plans would be prepared.	I: pp.307-310 M: #F-1, F-2, F-3, F-4	I: pp.307-310 M: #F-1, F-2, F-3, F-4	I: pp.307-310 M: #F-1, F-2	I: pp.307-310 M: #F-1, F-2		I: pp.307-312 M: #F-1, F-2, F-3, F-4			I: pp.307-312 M: #F-1, F-2, F-3, F-4
At the RWTP site, hazardous wastes might be encountered in the soils from debris in the former pool or encountered in the groundwater from a former service station. Construction dewatering might also accelerate migration of known contaminated groundwater. Sampling would be required.	I: pp.309-310 M: #F-14								
Based on a record search and review of historical aerial photos, there are indications of potential sources of hazardous materials from previous land uses at two sites. Soil or groundwater sampling would be conducted if necessary to determine if hazardous materials are present and if identified mitigation measures need to be implemented.		I: p.310 M: #F-12				I: pp.310-312 M: #F-1 to F-8			
Hazardous building materials present in the Fleishhacker Bath House would be removed prior to demolition to eliminate any potential for worker or public exposure to hazardous materials.	I: p.312 M: #F-11								

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Operation of the RWTP would involve handling chemicals which are considered hazardous, but handling and storage of chemicals would comply with applicable regulations.	I: pp.312-313 M: #F-15								
Transportation and Circulation									
Temporary construction-generated traffic would interact with, and could cause intermittent delays to, other vehicular traffic, including public transit.	I: pp.314-317 M: #G-1, G-7, G-8	I: pp.314-319 M: #G-1, G-7, G-8	I: pp.314-319 M: #G-1, G-7, G-8	I: pp.314-319 M: #G-1, G-7, G-8	I: pp.314-319 M: #G-1, G-7, G-8	I: p.319 M: #G-1 to G-8			I: p.319 M: #G-1 to G-8
Road closure during construction of Santiago Street between 22nd and 24th Avenues for McCoppin staging area, and of a portion of John F. Shelley Drive for McLaren Site 1 or 2, would temporarily divert local traffic to other streets in the vicinity and would affect local access.		I: p.319 M: #G-7, G-8	I: p.319 M: #G-7, G-8	I: p.319 M: #G-7, G-8	I: p.319 M: #G-7, G-8				
Construction of pipelines would temporarily cause reduction in travel lanes and street closures along pipeline routes, resulting in disruptions to existing traffic flows for vehicular traffic (including public transit), and bicycle and pedestrian.						I: pp.320-323 M: #G-1 to G-8			I: pp.320-323 M: #G-1 to G-8
Construction of pipelines could temporarily limit access to local residences and businesses along pipeline route.						I: pp.320-323 M: #G-1 to G-8			I: pp.320-323 M: #G-1 to G-8

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TABLE S-1: SUMMARY OF RWMP IMPACTS DISCUSSED IN EIR (Continued)

IMPACTS	NEAR-TERM FACILITIES PROJECTS						OPERATION		FUTURE PROJECTS
	RWTP and PS	RESERVOIRS							
	Fleishhacker Pool	Lincoln HS and PS	McLaren Park #1	McLaren Park #2	McCoppin Park Staging /1/	Transmission Pipes	RW System Operation	Recycled Water Use	Distribution Pipelines
Construction of pipelines could temporarily reduce on-street parking along pipeline route.						I: pp.320-323			I: pp.320-323
Air Quality									
Dust levels (including the respirable fraction, PM10) could temporarily exceed State PM10 standards within approximately 165 feet downwind of project construction areas.	I: pp.326-332 M: #H-1	I: pp.326-332 M: #H-1	I: pp.326-333 M: #H-1	I: pp.326-333 M: #H-1	I: pp.326-333 M: #H-1	I: pp.326-333 M: #H-1			I: pp.326-333 M: #H-1
Equipment exhaust emissions generated by project construction would not exceed Clean Air standards even if the maximum theoretical project impact coincides with the maximum background day.	I: pp.325-332 M: #H-2, H-4	I: pp.325-332 M: #H-2, H-4	I: pp.325-333 M: #H-2, H-4	I: pp.325-333 M: #H-2, H-4	I: pp.325-333 M: #H-2, H-4	I: pp.325-333 M: #H-2, H-4			I: pp.325-333 M: #H-2, H-4
Construction-related off-site truck emissions would not noticeably alter local exposure levels along proposed haul route, and would not exceed BAAQMD significance thresholds for regional air quality impacts.	I: pp.334-335	I: pp.334-336	I: pp.334-336	I: pp.334-336	I: pp.334-336	I: pp.334-336			I: pp.334-336
Excavation in areas of naturally occurring serpentine rock could release dust particles with asbestiform or silicate particles which could pose a health hazard without proper controls and disposal.	I: pp.329-330 M: #H-3, F-10	I: pp.329-339 M: #H-3, F-10	I: pp.329-330 M: #H-3, F-10	I: pp.329-330 M: #H-3, F-10		I: pp.329-330 M: #H-3, F-10			I: pp.329-330 M: #H-3, F-10

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	RWTP and PS	RESERVOIRS							
	Fleishhacker Pool	Lincoln HS and PS	McLaren Park #1	McLaren Park #2	McCoppin Park Staging /1/	Transmission Pipes	RW System Operation	Recycled Water Use	Distribution Pipelines
Simultaneous construction of planned Zoo projects with RWMP projects would result in greater area of disturbance and cumulative dust (PM10) and equipment exhaust emissions.	I: pp.336-337								
Noise and Vibration									
Construction activities at RWMP sites could cause temporary noise increases which could disturb nearby sensitive receptors. With feasible noise controls, noise levels are not expected to exceed the speech interference criterion, except possibly along pipeline routes. Along pipeline routes, noise levels could at times interfere with speech during the 1- to 2-week construction period at any given residence.	I: pp.343-349 M: #I-1 to I-11, I-15	I: pp.343-351 M: #I-1 to I-11	I: pp.343-352 M: #I-1 to I-11, I-16	I: pp.343-352 M: #I-1 to I-11, I-16	I: pp.349-351 M: #I-1 to I-11	I: pp.352-353 M: #I-1 to I-11			I: pp.352-353 M: #I-1 to I-11
If sheetpiles are used for shoring and sheetpile driving is required, exterior noise levels would exceed the speech interference criterion at nearby sensitive receptors at scattered intervals during the 4-6 month earthwork phase for periods of 1-2 weeks.	I: p.346 M: #I-9	I: p.350 M: #I-9, I-10	I: p.351 M: #I-9, I-10	I: p.351 M: #I-9, I-10	I: p.350 M: #I-9, I-10	I: pp.352-353 M: #I-9, I-10			I: pp.352-353 M: #I-9, I-10
Residences along haul routes would be subject to temporary noise increases from haul trucks, and noise levels from passing trucks could result in individual noise peaks that briefly interfere with speech in rooms facing the street.	I: p.349 M: #I-4	I: pp.350-351 M: #I-4	I: pp.351-352 M: #I-4	I: pp.351-352 M: #I-4	I: pp.350-351 M: #I-4	I: p.353 M: #I-4			I: p.353 M: #I-4

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IMPACTS	NEAR-TERM FACILITIES PROJECTS						OPERATION		FUTURE PROJECTS
	RWTP and PS	RESERVOIRS							
	Fleishhacker Pool	Lincoln HS and PS	McLaren Park #1	McLaren Park #2	McCoppin Park Staging /1/	Transmission Pipes	RW System Operation	Recycled Water Use	Distribution Pipelines
Simultaneous construction could result in more frequent noise peaks in adjacent areas due to equipment operation at the RWTP site and adjacent Zoo improvement project sites.	I: pp.353-354 M: #I-15								
If sheetpiles are used for shoring, temporary vibration effects could occur.	I: pp.354-356 M: #I-9, I-11, I-12	I: pp.354-357 M: #I-9, I-11, I-12	I: pp.354-357 M: #I-9, I-11, I-12	I: pp.354-357 M: #I-9, I-11, I-12		I: p.357 M: #I-9, I-11, I-12			I: p.357 M: #I-9, I-11, I-12
Operation of facilities (pumps or air blowers) could result in noise increases above existing ambient noise levels and would require provision of noise attenuation measures.	I: pp.358-361 M: #I-13, I-14	I: p.362 M: #I-13, I-14							
Biological Resources									
The projected recycled water quality would generally be acceptable for irrigation of most typical landscape plants used in the City. Some plants could have specific sensitivities. SFWD would coordinate with landscape managers so that they can make appropriate adjustments in irrigation and fertilization practices due to differences in water quality.								I: pp.363-370 M: #J-9	

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	NEAR-TERM FACILITIES PROJECTS						OPERATION		FUTURE PROJECTS
	RWTP and PS	RESERVOIRS							
IMPACTS	Fleishhacker Pool	Lincoln HS and PS	McLaren Park #1	McLaren Park #2	McCoppin Park Staging /1/	Transmission Pipes	RW System Operation	Recycled Water Use	Distribution Pipelines
Construction of RWMP facilities would necessitate removal and replacement of mature trees, landscaping and turf grass at several sites. At the RWTP site, a portion of a landscaped berm would be removed. At Lincoln reservoir site up to 10 trees and about 2.8 acres of turf grass would be removed. At McLaren Site 1, about 15 trees and about 1.5 acres of non-native grass would be removed. At McLaren Site 2, up to 23 trees and about 4 acres of grass would be removed.	I: pp.370-371 M: #J-3	I: pp.371-372 M: #J-2, J-4, J-6, J-8	I: p.372 M: #J-2, J-5, J-6, J-8	I: pp.372-373 M: #J-2, J-5, J-6, J-8					
There is a remote possibility that the Monarch butterfly would occur at the two reservoir sites. The City would conduct surveys prior to construction to determine if identified mitigation measures should be implemented.		I: p.371 M: #J-7	I: pp.372-373 M: #J-7	I: pp.372-373 M: #J-7	I: p.371 M: #J-7				
At the McCoppin Square staging area, no tree removal is proposed but construction staging could cause root compaction and other impacts to mature trees that might necessitate replacement.					I: p.371 M: #J-6				
Cultural Resources									
Construction of the RWTP at the Fleishhacker site would involve demolition of the Fleishhacker Bath House, which is not considered eligible for the National Register of Historic Places. Demolition of this structure has previously been approved for other projects.	I: pp.374-375								

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	RWTP and PS	RESERVOIRS							
	Fleishhacker Pool	Lincoln HS and PS	McLaren Park #1	McLaren Park #2	McCoppin Park Staging /1/	Transmission Pipes	RW System Operation	Recycled Water Use	Distribution Pipelines
Construction of subsurface portions of project facilities would require excavation. Although there are no recorded cultural resource sites at any of the proposed project sites, the potential for encountering subsurface resources during excavation activities would still exist.	I: p.375 M: #K-1, K-2	I: p.375 M: #K-1, K-2	I: p.375 M: #K-1, K-2	I: p.375 M: #K-1, K-2		I: p.375 M: #K-1, K-2			
Energy and Natural Resources									
The RWMP would increase energy demand by 14.7 million kWh per year, equal to about 0.1% of the total annual electricity demand in 1980 by all of San Francisco. This would be partially offset by the energy saved from pumping less groundwater at the Zoo and Golden Gate Park.	I: pp.376-377	I: p.377					I: pp.376-377		

/1/ McCoppin Park would serve as an offsite staging area for Lincoln and Golden Gate Heights reservoir sites. The staging area for both McLaren reservoir sites and the Fleishhacker RWTP site would be on site.

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GROUNDWATER MASTER PLAN

Facilities and Project Sites

Westside Basin - Production Wells and Pipelines

Elk Glen Well. Construction would disturb biological resources (grasses and shrubs) and would displace existing land uses on about 1,800 to 2,000 square feet of area on the Elk Glen Well Site for about eight weeks. The site is adjacent to a park path and Elk Glen Lake, and the site is used for walking, horseback riding and other park enjoyment activities. Due to the site's distance from residences and other sensitive receptors, dust and noise generated by well construction would not be expected to violate any standards. However, visual, dust, noise and vibration impacts of construction would be noticeable to surrounding park users during the construction period. Dust control, and noise and vibration attenuation strategies would be employed to minimize these impacts. Erosion control measures would be implemented to minimize the potential for erosion impacts at the site due to construction excavation and earthmoving activities.

The Elk Glen Well site is zoned "P" -- Public Use District. Construction of chlorination facilities associated with the rehabilitated well would permanently convert a portion of the site to a public utility use. The Rec Park Commission must make a determination of whether the proposed well rehabilitation and chlorination facility are consistent with the City park uses. In the event the Commission determines they are not, the City Charter requires a public vote on the proposed use. The completed facilities would permanently replace the existing open space land uses on an area of about 640 feet and would permanently alter the visual character of the site. The SFWD would work with the Recreation and Park Department to design plans for revegetation of the area to provide visual screening of the structure. Noise attenuation devices would be used to minimize the effects of pump operational noise to park visitors in the vicinity.

Sunset Wells. Construction would temporarily displace existing land uses on about 1,800 to 2,000 square feet of area on the Sunset Well sites for about eight weeks. The completed wells and associated chlorination facilities on each site would permanently replace the existing land uses on an area of about 640 square feet. At the Francis School Key School site, the area to be disturbed is a paved portion of the school's playground, containing a basketball court. The DPW would work with the School District to provide interim play areas at this site and to replace any play structures affected by construction. At the West Sunset Playground site, the area to be disturbed is currently a paved parking lot.

Construction could cause PM_{10} levels exceeding state (but not federal) standards, and noise and vibration which could temporarily affect adjacent land uses. Dust control, and noise and vibration attenuation strategies would be employed to minimize these impacts. At the Francis Scott Key School, the nearest land uses are adjacent school uses, and residences across the street from the site. The nearest land uses at the West Sunset Playground site are the adjacent parking and ballfield uses, and residences across the street from the site. Assuming feasible noise controls are implemented, noise levels at nearby residential and school uses during construction could result in interference with speech, and it may be necessary to keep windows closed at times during the eight-week construction period in order to minimize speech interference effects.

The proposed Sunset District well sites are all zoned "P" -- Public Use District. Construction of a well and associated chlorination facilities on each site would permanently convert a portion of the site to a public utility use, and use of Francis Scott Key School would require approval by the School District. For use of the West Sunset Playground, the Rec Park Commission must make a determination of whether the proposed well and chlorination facility are consistent with the City park uses. In the event the Commission determines they are not, the City Charter requires a public vote on the proposed use. The completed structure would permanently replace the existing school uses or parking uses on an area of about 640 feet. The SFWD would work with the School District and Recreation and Park Department to replace any structures affected by construction. Noise attenuation devices would be used to minimize the effects of pump operational noise to nearby residents and schools.

Well Pipelines. Pipeline construction activities and heavy equipment use in city streets could temporarily disrupt existing transportation and circulation patterns in the vicinity of the proposed pipeline alignments. Lane blockages or street closures, when required during pipeline installation, would result in a reduction in travel lanes and curb parking, and could result in the need for traffic re-routing. Public transit routes, pedestrian and bicycle traffic and access to businesses and residences could also could be disrupted during construction, although pipeline construction would generally occur at the rate of 50 to 100 feet per day and disruption within any given block would generally last about one week. Traffic control and safety measures would be employed to minimize the effects of construction on local traffic.

Construction activities could result in PM_{10} levels exceeding state (but not federal) standards, adversely affecting residents living along pipeline routes for a short period. Construction activities could cause temporary noise and vibration increases which could also disturb adjacent residential uses along pipeline routes. Dust control, and noise and vibration attenuation

strategies would be employed to minimize these impacts. The maximum depth of pipeline trenches would be about 5 feet deep, and it is not anticipated that native rock containing asbestos would be encountered; if such an event were to occur, dust control, sampling and monitoring would be conducted to prevent potential public health impacts.

BART Station Dewatering and Reuse

Installation of pumping and injection equipment would capture groundwater that is currently being discharged to the sewer system and inject it to the AWSS. This would reduce the daily loading to the sewer system as well as increase the water supply reliability of the AWSS. Neither construction nor operation of dewatering facilities at the Powell Street BART station would be expected to result in noticeable physical environmental effects relative to the existing urbanized land use at the site. Neither construction nor operation would affect any sensitive receptors since facilities would be located almost entirely underground and there are no sensitive receptors in the vicinity.

Westside Basin (South) In-Lieu Recharge

A proposed short-term activity under the GWMP would be to conduct "in-lieu recharge" in the southern portion of the Westside Groundwater Basin in coordination with various jurisdictions south of San Francisco. This would be a resource management activity in which the City would provide imported surface water from the SFWD system to groundwater users in this area during periods when surplus surface water is available. In exchange, the groundwater users would reduce or cease groundwater pumping during these periods, and natural groundwater recharge could occur and groundwater could accumulate and be stored in the basin. During dry years when surface water supplies are limited, the groundwater users could resume pumping as necessary. This "in-lieu recharge" activity is a type of conjunctive use program (coordinated use of surface and ground waters) and could help counteract the declining water levels in Lake Merced. This activity would also promote more efficient use of water resources than the current approach. The City has already initiated discussions with the cities of Daly City and San Bruno and with the California Water Service Company regarding such coordination of groundwater management. Once a specific in-lieu recharge project(s) is developed it would be subject to additional, detailed project-level CEQA review tiered from this Program EIR.

Potential Future Wells (Production/Injection/Monitoring)

As the GWMP is implemented, additional wells (i.e., production, injection and/or monitoring wells) would be proposed for development. The well projects would be subject to additional, detailed site-specific investigation of feasibility, suitability and impact. As appropriate, SFWD would complete additional CEQA environmental review for these projects tiered from this Program EIR analysis.

In general, these future wells would have impacts similar to those described for the specific near-term production well projects analyzed in this EIR (Elk Glen Well and the two Sunset District wells). Construction of production or injection wells would require approximately eight weeks and would result in localized land use disruption and disturbance (e.g., noise, dust, traffic) to surrounding uses. Operation of proposed future wells would be analyzed for potential impacts including salt water intrusion, subsidence, water quality degradation, and effect on safe yield.

Groundwater Management

The GWMP would provide goals for the long-term management, development and use of groundwater resources in San Francisco where currently none exist. Even though groundwater has been historically and is currently used, the GWMP would be the first centralized, comprehensive management program for groundwater resources. It would provide coordination between City agencies as well as with other jurisdictions, provide oversight for both private and public users, and cover both potable and non-potable uses of groundwater. By providing a local rather than imported source of water and by augmenting the existing supply, the GWMP would increase the overall reliability of the City's water supply system.

The GWMP would maximize groundwater use while at the same time protecting and enhancing groundwater quality. Proposed programs to protect groundwater quality would include prevention of saltwater intrusion, wellhead protection, and comprehensive groundwater monitoring. The GWMP would also include activities to protect and conserve surface water resources related to the groundwater system, such as Lake Merced and Lobos Creek. Additional studies and field investigations would be conducted under the GWMP to collect adequate information that would allow comprehensive resource protection. Management of groundwater on a basinwide-basis would facilitate coordinated groundwater pumping, storage and monitoring, and would enable the basins to be maintained as long-term resources.

Preliminary studies conducted for the GWMP have indicated that of the seven groundwater basins underlying San Francisco, the three basins with the highest potential for development are the Westside, Downtown and Lobos basins. The Westside Basin has the largest capacity of the groundwater basins, has the highest volume of recharge, and the groundwater quality appears to be of potable quality. The Downtown Basin has a relatively large capacity and a high recharge rate, but due to the extent of historic industrial and manufacturing land uses, the groundwater is not expected to be potable; however, the basin is considered to have potential for future groundwater development for selected non-potable uses. The groundwater in the Lobos Basin has historically been used as a potable water supply, and there is potential developing a conjunctive use program in this basin. There is limited hydrogeologic information on the other four groundwater basins (Marina, Islais Valley, South, and Visitacion Valley basins), and additional studies, as proposed under the GWMP, are needed to determine their development potential.

System-wide/Operational Effects

Water System Operation

The proposed potable uses of groundwater would include incorporation of treated groundwater into the City's potable water supply system, either to the local or main distribution system. In general, the groundwater would be treated and blended with the City's imported surface water supply before delivery to the water customers in the City. Although the groundwater would be of potable quality and would meet Drinking Water Standards, the quality of the groundwater would be different from the City's current water supply. The differences in quality could result in discernible changes in taste of the water supply, depending on the degree of blending with the current supply. Additionally blending of surface and groundwater can also exacerbate corrosion. The effects of the GWMP on increased water supply are discussed below under *Water Supply Effects and Growth Inducement Potential.*

Fire System Operation

The proposed activity to divert groundwater discharge from the Powell Street BART Station to the AWSS would augment the AWSS water supply, and would reduce discharge to the sewer system. The water supply from the BART Station dewatering discharge would provide a degree of increased reliability of fire system water supply, especially since it would be a local rather than imported water supply source. In addition, the goal to evaluate use of groundwater as an

emergency reserve could eventually provide further, more extensive augmentation of the AWSS water supply system.

Energy

Most of the short-term activities specified in the GWMP would not require energy. Energy demand would be associated with construction and operation of some near-term projects under the GWMP. Energy for construction would be supplied primarily by portable generators. Under the proposed conjunctive use program, the City would supply surface water to the southern portion of the Westside Basin during wet years, and pumping energy requirements for the surface water would be offset by the reduction or cessation of groundwater pumping. The short-term activities in the GWMP that would produce new energy demand would be the operation of the Elk Glen Well, the Sunset District wells, and the Powell Street BART Station dewatering facility. Groundwater pumps and chlorination facilities would be the primary source of increased energy demand associated with these groundwater facilities, and energy demands would total approximately 3 million kWh per year.

TABLE S-2: SUMMARY OF GWMP IMPACTS DISCUSSED IN EIR - MANAGEMENT AND USE

IMPACTS	RESOURCE MANAGEMENT /1/						USE /2/	
	Production				Recharge			
	All Basins	Westside Basin	Lobos Basin	Downtown Basin	All Basins	Westside Basin	Potable	Non-Potable
Land Use/Visual								
No land use or visual effects would be associated with proposed groundwater management goals or activities.								
Groundwater and Surface Water Resources								
The proposed management goals and activities would establish formal groundwater management structure and procedures both within City agencies and with other jurisdictions where none currently exists. This would provide long-term protection of groundwater resources.	I: pp.385-386 M: #B-1, B-2							
Implementation of development goals would increase groundwater production from City basins. The most promising basin for additional development is Westside followed by the Downtown and Lobos Basins. Implementation of proposed management goals would mitigate any potential impacts associated with additional groundwater development.	I: pp.397-399 M: #B-1, B-2	I: pp.398-399 M: #B-1 B-2	I: p.396 M: #B-1, B-2					
Implementation of the management goals would provide long-term protection of groundwater quality through prevention of saltwater intrusion, wellhead protection, and comprehensive groundwater monitoring.	I: pp.386-394							
Proposed conjunctive use programs would increase efficient use of water resources.		I: pp.394-395	I: pp.394-395			I: pp.394-395	I: pp.394-395	I: pp.394-395
Surface waters such as Lake Merced and Lobos Creek would be managed and protected as part of the groundwater system.		I: pp.395-397	I: pp.395-397					
The City could have long-term improved reliability in providing water during emergency conditions.	I: p.397 M: #B-2						I: p.397 M: #B-2	I: p.397

Key: I - Impact; M - Mitigation; PS - Pump Station; GW - Groundwater; GWMP - Groundwater Water Master Plan

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TABLE S-2: SUMMARY OF GWMP IMPACTS DISCUSSED IN EIR - MANAGEMENT AND USE (Continued)

IMPACTS	RESOURCE MANAGEMENT /1/						USE /2/	
	Production				Recharge			
	All Basins	Westside Basin	Lobos Basin	Downtown Basin	All Basins	Westside Basin	Potable	Non-Potable
Public Health and Water Quality								
Groundwater development for potable water supply uses would be required to meet federal and state drinking water regulations so that no public health effects would be expected. Depending on the groundwater and the degree of blending with other water sources, there may be discernible changes in taste of the water supply.		I: pp.401-405 M: #C-12, C-13	I: pp.401-405 M: #C-12, C-13				I: pp.401-405 M: #C-12, C-13	
Groundwater developed for non-potable uses, such as for use in the AWSS, would be tested to ensure suitable quality for the designated use, so that no public health effects would be expected.				I: pp.405-407 M: #C-1				I: pp.405-407 M: #C-1
Public Services and Utilities								
Groundwater developed for potable use could be injected into the existing potable water supply system with no interruption of services, and the additional water supply would increase the overall reliability of the system.	I: pp.408-409 M: #C-12	I: pp.408-409 M: #C-12					I: pp.408-409 M: #C-12	
Geology, Soils and Seismicity								
Groundwater extraction could potentially result in ground subsidence, depending on site-specific geologic conditions and the rate of groundwater pumping.	I: pp.411-412 M: #E-9							
Hazardous Materials								
The proposed wellhead protection program would reduce the potential for hazardous materials to contaminate groundwater resources.	I: p.415							
Biological Resources								
Terrestrial biological resources would not be directly affected by the proposed groundwater management goals or activities.								

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TABLE S-2: SUMMARY OF GWMP IMPACTS DISCUSSED IN EIR - MANAGEMENT AND USE (Continued)

	RESOURCE MANAGEMENT /1/						USE /2/	
	Production				Recharge			
IMPACTS	All Basins	Westside Basin	Lobos Basin	Downtown Basin	All Basins	Westside Basin	Potable	Non-Potable
Protection of lakes and streams associated with groundwater systems would provide additional protection of associated aquatic habitats.		I: p.431	I: p.431					
Transportation and Circulation; Air Quality; Noise and Vibration; Cultural Resources; Energy								
These impact areas would not be directly affected by the proposed groundwater management goals or activities.								

/1/ Resource Management Impacts are the effects of groundwater use and management on the groundwater basin.
/2/ Use impacts are the effects of groundwater use upon the area in which it is used or upon the users.

Key: I - Impact; M - Mitigation; PS - Pump Station; GW - Groundwater; GWMP - Groundwater Water Master Plan

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TABLE S-3: SUMMARY OF GWMP IMPACTS DISCUSSED IN EIR- NEAR-TERM AND FUTURE PROJECTS

	NEAR-TERM PROJECTS						FUTURE PROJECTS	
	Westside Basin North - Wells			Pipelines				
	GG Park	Sunset District						
IMPACTS	Elk Glen Well	Francis Scott Key School	West Sunset Playground	All Westside Well Projects	Powell Street BART Station Dewatering	In-Lieu Reharge - Westside Basin	Future Wells	Future Pipelines
Land Use/Visual								
Well construction would cause temporary disruption of 2,000 square feet of on-site land uses during construction; but existing uses could continue in adjacent areas.	I: pp.378-380 M: #A-5	I: pp.381-382	I: pp.381-382		I: pp.382-383			
Well construction would result in permanent displacement of an area of about 640 square feet.	I: p.379 M: #A-4, A-6	I: p.381 M: #A-7	I: p.381 M: #A-8					
Construction of a 15-foot high structure within a 640-square foot fenced area would not substantially alter the visual character of any site.	I: pp.380-381 M: #A-6	I: p.382 M: #A-7	I: p.382 M: #A-8					
The BART Station dewatering reuse project would have no temporary or permanent land use or visual effects					I: p.383			
Pipeline construction would cause no temporary or permanent displacement of land uses.				I: pp.383-384				
Groundwater and Surface Water Resources								
Groundwater from the northern portion of the Westside Basin would be extracted for potable uses at a rate of about 1,000 ac-ft/yr.	I: pp.398-400 M: #B-9	I: pp.398-400 M: #B-9	I: pp.398-400 M: #B-9					
About 150 ac-ft/yr of groundwater from dewatering operations currently disposed of in the sewer system would be used as an additional water supply source for the AWSS.					I: p.400			

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	NEAR-TERM PROJECTS						FUTURE PROJECTS	
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	GG Park	Sunset District						
IMPACTS	Elk Glen Well	Francis Scott Key School	West Sunset Playground	All Westside Well Projects	Powell Street BART Station Dewatering	In-Lieu Reharge - Westside Basin	Future Wells	Future Pipelines
The in-lieu recharge program would alter the current groundwater pumping regime in the southern portion of the Westside Basin: pumping would be reduced on an average annual basis as current groundwater pumpers receive surface water supply from SFWD during "normal" to "wet" years; this would increase groundwater elevations in the basin. During drought periods, groundwater pumping would resume at current levels or greater as in-lieu surface supply becomes unavailable. Additional analysis of in-lieu pumping scenarios and groundwater affects is required once the project is better defined.						I: pp.394-395		
The in-lieu recharge program could result in increasing water levels in Lake Merced; it could restore lake levels to observed historic levels.						I: pp.394-395		
Public Health and Water Quality								
Groundwater development for potable water supply uses would be required to meet federal and state drinking water regulations so that no public health effects would be expected. Depending on the groundwater and the degree of blending with other water sources, there may be discernible changes in taste of the water supply.	I: pp.401-405 M: #C-12, C-13	I: pp.401-405 M: #C-12 C-13	I: pp.401-405 M: #C-12 C-13				I: pp.401-405 M: #C-12 C-13	
Groundwater developed for non-potable uses, such as for use in the AWSS, would be tested to ensure suitable quality for the designated use, so that no public health effects would be expected.					I: pp.405-407 M: #C-1		I: pp.405-407 M: #C-1	

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	NEAR-TERM PROJECTS						FUTURE PROJECTS	
	Westside Basin North - Wells			Pipelines				
	GG Park	Sunset District						
IMPACTS	Elk Glen Well	Francis Scott Key School	West Sunset Playground	All Westside Well Projects	Powell Street BART Station Dewatering	In-Lieu Reharge - Westside Basin	Future Wells	Future Pipelines
Public Services and Utilities								
Groundwater developed for potable use would be injected into the existing potable water supply system with no interruption of services, and the additional water supply would increase the overall reliability of the system.	I: pp.408-409 M: #C-12	I: pp.408-409 M: #C-12	I: pp.408-409 M: #C-12					
Groundwater development proposed to supplement the non-potable AWSS water supply would increase the overall reliability of the fire protection system and would decrease discharge to sewer system.					I: p.409			
Dewatering discharge from the Powell Street BART Station (150 ac-ft/yr) would no longer be disposed of in the sewer system but would be injected to the AWSS.					I: p.409			
Geology, Soils and Seismicity								
Excavation and earthmoving activities during construction at all sites could result in excess erosion to surface waters or the sewer system if adequate controls are not implemented.	I: p.412 M: #E-3, E-5	I: p.412 M: #E-3, E-5	I: p.412 M: #E-3, E-5	I: p.412 M: #E-3, E-5			I: p.412 M: #E-3, E-5	I: p.412 M: #E-3, E-5
All facilities would be subject to seismic hazards, such as seismic shaking, lurching, liquefaction, densification and subsidence, which would be considered during the design phase.	I: p.413 M: #E-1, E-2	I: p.413 M: #E-1, E-2	I: p.413 M: #E-1, E-2	I: p.413 M: #E-1, E-2			I: p.413 M: #E-1, E-2	I: p.413 M: #E-1, E-2

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	NEAR-TERM PROJECTS						FUTURE PROJECTS	
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	GG Park	Sunset District						
IMPACTS	Elk Glen Well	Francis Scott Key School	West Sunset Playground	All Westside Well Projects	Powell Street BART Station Dewatering	In-Lieu Reharge - Westside Basin	Future Wells	Future Pipelines
All facilities would be subject to potential geologic and engineering constraints, such as differential settlement and corrosion, which would be considered during the design phase.	I: p.413 M: #E-1, E-4	I: p.413 M: #E-1, E-4	I: p.413 M: #E-1, E-4	I: p.413 M: #E-1, E-4			I: p.413 M: #E-1, E-4	I: p.413 M: #E-1, E-4
Hazardous Materials								
Groundwater development would involve excavation activities which could result in exposure of subsurface hazardous materials from previous land uses. Preliminary well site screening investigations, however, would likely eliminate sites that have potential to encounter hazardous materials.	I: pp.414-415 M: #F-16	I: pp.414-415 M: #F-16	I: pp.414-415 M: #F-16	I: p.415 M: #F-1	I: pp.415-416 M: #F-7		I: p.414 M: #F-16	I: p.415 M: #F-16
If groundwater contamination is present in the vicinity of areas of groundwater development, groundwater pumping could accelerate the flow of contaminants or could affect remediation activities.					I: pp.415-416 M: #F-18			
Disinfection chemicals used at each well site for treatment of potable groundwater would pose a potential public health concern; on-site safety features would minimize this impact.	I: pp.416-417 M: #F-17	I: pp.416-417 M: #F-17	I: pp.416-417 M: #F-17					
Transportation and Circulation								
Temporary construction-generated traffic, including large trucks, would interact with, and could cause intermittent delays to, other vehicular traffic, including public transit.	I: pp.418-420 M: #G-7, G-8	I: pp.418-420 M: #G-7, G-8	I: pp.418-420 M: #G-7, G-8	I: pp.418-419 M: #G-7, G-8			I: pp.418-420 M: #G-7, G-8	I: pp.418-419 M: #G-7, G-8

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IMPACTS	Elk Glen Well	Francis Scott Key School	West Sunset Playground	All Westside Well Projects	Powell Street BART Station Dewatering	In-Lieu Reharge - Westside Basin	Future Wells	Future Pipelines
Temporary pipeline-associated construction would cause temporary reduction in travel lanes and street closures along pipeline route, resulting in short-term disruptions to existing traffic flows, including vehicular, public transit, and bicycle and pedestrian traffic.				I: pp.420-423 M: #G-1 to G-8				I: pp.420-423 M: #G-1 to G-8
Temporary pipeline-associated construction could limit access to local residences and businesses along pipeline route.				I: pp.420-423 M: #G-1 to G-8				I: pp.420-423 M: #G-1 to G-8
Temporary pipeline-associated construction could temporarily reduce on-street parking along pipeline route.				I: pp.420-423 M: #G-1 to G-8				I: pp.420-423 M: #G-1 to G-8
Air Quality								
Dust levels (including the respirable fraction, PM10) could temporarily exceed state PM10 standards within approximately 165 feet downwind of project construction areas.	I: pp.424-425 M: #H-1	I: pp.424-425 M: #H-1	I: pp.424-425 M: #H-1	I: pp.424-425 M: #H-1			I: pp.424-425 M: #H-1	I: pp.424-425 M: #H-1
Noise and Vibration								
Construction could cause temporary noise increases which could disturb nearby sensitive receptors. With feasible noise controls, noise levels could interfere with speech at times during the 1- to 2-week construction period at any given residence.		I: p.427 M: #I-1 to I-8	I: p.427 M: #I-1 to I-8	I: pp.427-428 M: #I-1 to I-8				I: pp.427-428 M: #I-1 to I-8

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IMPACTS	Elk Glen Well	Francis Scott Key School	West Sunset Playground	All Westside Well Projects	Powell Street BART Station Dewatering	In-Lieu Reharge - Westside Basin	Future Wells	Future Pipelines
During construction, assuming feasible noise controls are implemented, noise levels at nearby residential and school uses could require that windows may be closed at times in order to minimize speech interference effects.		I: p.427 M: #I-1 to I-8	I: p.427 M: #I-1 to I-8				I: p.426 M: #I-1 to I-8	
Operation of well pumps could generate noise levels that could be noticeable during the nighttime hours if pumps were operated at night and wall louvers were located facing sensitive receptors.	I: pp.428-429 M: #I-14	I: p.429 M: #I-14	I: p.429 M: #I-14				I: p.428 M: #I-14	
Biological Resources								
Well construction would temporarily disturb about 2,000 square feet of grasses adjacent to Elk Glen Lake, of which about 640 square feet would be permanently replaced by well facilities.	I: p.430 M: #J-10							
No biological resources would be affected by construction of well facilities at these sites.		I: p.430	I: p.430	I: p.430	I: p.430			
If in-lieu recharge results in increasing water levels in Lake Merced this would expand and improve aquatic, fisheries, and waterbird habitat and there could be some conversion of freshwater marsh tule habitat to shallow water habitat around the perimeter of the lake.						I: pp.430-431		

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IMPACTS	Elk Glen Well	Francis Scott Key School	West Sunset Playground	All Westside Well Projects	Powell Street BART Station Dewatering	In-Lieu Reharge - Westside Basin	Future Wells	Future Pipelines
Cultural Resources								
No recorded cultural resources are known to exist in the vicinity of the well sites, but unrecorded archaeological sites may exist. There would be the potential to encounter unrecorded cultural resources during construction of facilities, but an archaeologist would be available to determine if control measures are necessary.	I: p.432 M: #K-1	I: p.432 M: #K-1	I: p.432 M: #K-1	I: p.432 M: #K-1	I: p.432 M: #K-1			
Energy and Natural Resources								
Of short-term projects identified in the GWMP, groundwater well pumps would be the primary source of increased energy demand associated with these groundwater facilities, and total energy demands would be approximately 3 million kWh per year.	I: pp.433-434	I: pp.433-434	I: pp.433-434		I: p.434		I: p.433	
Over the long-term, energy to provide surface water to users during wet years would be offset by reduced energy from reduction or cessation of groundwater pumping.						I: p.433		

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CUMULATIVE IMPACTS WITH OTHER PLANNED OR PROPOSED PROJECTS

Portions of the San Francisco Zoological Gardens improvements proposed in the *San Francisco Zoological Gardens Infrastructure Master Plan* (Zoo Infrastructure Master Plan) and the *San Francisco Zoological Gardens Master Plan* (Zoo Master Plan) would occur in the vicinity of the Fleishhacker RWTP site.[1, 2] Simultaneous construction of the RWTP and major Zoo improvements could result in a greater area of disturbance at one time, which would result in greater dust (PM_{10}) and equipment exhaust emissions. Simultaneous construction could also result in more frequent noise peaks in adjacent areas due to equipment operation and greater impacts to local traffic.

DPW is coordinating timing of construction with the Zoo staff to increase the efficiency of construction in the RWTP vicinity and to prevent construction conflicts between Zoo and RWMP projects. The majority of Zoo Infrastructure Master Plan projects in the vicinity of the project site would be completed before RWTP construction would begin (see Figure 39, p. 123, Schedule of Zoo and RWTP Projects). In addition, dust control, noise and vibration attenuation strategies, and traffic control and safety measures would be employed to minimize the construction impact of the RWMP project.

Land uses and visual character of the completed RWTP and Zoo facilities could conflict if not coordinated. DPW is coordinating with the Zoo staff to ensure that the location, design and use of RWTP facilities are compatible with the existing uses and uses proposed in the two Zoo planning documents for the Fleishhacker Pool site and vicinity.

E. SUMMARY OF WATER SUPPLY EFFECT AND GROWTH INDUCEMENT (pp. 435 to 471)

Implementation of both the RWMP and the GWMP would supplement the water supply for the City. The RWMP would provide a new supply of non-potable water that would replace the current use of potable water for non-potable uses, and in effect would "save" potable water. The GWMP would provide a framework, including some specific projects, for development of both

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1 *San Francisco Zoological Gardens Infrastructure Master Plan*, Final, prepared by Kennedy Jenks - AGS, Inc., an Association, for the City and County of San Francisco Department of Public Works, August, 1995.

2 *San Francisco Zoological Gardens Master Plan*, prepared by Portico, Inc., for the San Francisco Zoological Society, June 1994.

additional potable and non-potable water supply from the City's groundwater resources. The cumulative contribution of the RWMP and GWMP to the City's water supply would be to increase the available potable water supply by 12.1 million gallons daily (13,500 acre-feet per year) by the year 2011.

Based on existing and projected water supply deficits in the City and in the area served by the SFWD, the RWMP and the GWMP could reduce the potential constraint to growth represented by water supply. However, the growth inducement potential would depend on numerous factors besides water supply. Both current and projected demand exceeds the current and projected water supply. The amount of potable water saved by the RWMP and the GWMP would not fully alleviate water shortages in drought periods. Storage of excess water during wet years for use during dry years would be necessary to meet this demand, but the existing system does not have any additional water storage capacity. Additional technical analysis is needed to determine the feasibility of a conjunctive use program to store surface water in the City's groundwater basins during wet years to meet demand during dry years or emergencies.

F. SUMMARY OF MITIGATION MEASURES (pp. 472 to 498)

Mitigation measures that have been included in the proposed project are presented in terms of those applicable to both the RWMP and the GWMP, to the RWMP only, and the GWMP only. The measures also apply to various phases of plan implementation, either the planning and design phase, construction phase, or operation phase. Major mitigation measures incorporated into the proposed project have been discussed above under *Summary of Impacts*, which describes the physical environmental effects assuming implementation of mitigation measures.

In general, measures to be implemented during the planning and design phase would include measures incorporated as plan policies, technical studies to be completed prior to facility design, and measures incorporated into the facility design. These would include coordination with regulatory agencies and with current site users, site-specific geotechnical investigations, and incorporation of other detailed, site-specific design considerations to be completed during the planning and design phase.

Measures to be implemented as part of the construction phase would take place either prior to, during or immediately after construction. These would primarily include measures to minimize effects of construction activities on air quality (dust), noise, vibration, groundwater, erosion, hazardous materials, cultural resources, and overall traffic and community disruption, plus

measures to restore sites and the immediate vicinity for long-term compatible or joint uses. Control measures to minimize construction-related dust, noise, vibration, and traffic effects would be implemented and monitored at each facility site for the duration of construction, and these measures would be targeted to minimize effects on sensitive receptors, such as current site users, nearby residences, or sensitive animals at the Zoo. During construction, contingency plans would also be established to address hazardous materials or cultural resources in the event they are encountered during construction.

Operational measures to assure minimal environmental effects during long-term operation of project facilities would consist mainly of ongoing coordination/notification with regulatory agencies and affected parties, on-going monitoring of water quality, and provision of back-up systems.

All mitigation measures that are made conditions of project approval would be enforced through a reporting and/or monitoring program under the auspices of the Department of City Planning and other City agencies.

G. ALTERNATIVES (pp. 502 to 524)

Both program-level and project-level alternatives to the RWMP and GWMP are considered. Program level alternatives apply to both plans and include other conceptual programs that could in some sense achieve the shared objectives of the RWMP and GWMP. The program alternatives analyzed include (1) No Project Alternative, as required by CEQA (including combinations of not implementing one or both the RWMP and GWMP) and (2) additional storage for Hetch Hetchy water alternative, which would increase existing the water supply by increasing the storage capacity of the system. Neither of these alternatives would achieve all the shared objectives of the RWMP and GWMP, primarily the objective of coordinating management and conservation of the City's surface, ground and recycled water supply resources. Additional program alternatives examined but were determined to be infeasible include water conservation, other sources of water supply, and new surface water storage facilities. The proposed RWMP and GWMP are determined to be the environmentally superior program level alternative.

Project level alternatives for the RWMP apply to one or more component of the RWMP, and the alternatives analyzed include (1) alternative sites for recycled water storage reservoirs, and (2) alternative site locations for the RWTP. The first alternative considered about 50 alternative

locations but any of the sites would not substantially avoid or minimize the impacts associated with construction of project reservoirs at the proposed sites, but some of the alternative sites cannot accommodate reservoirs as large as the proposed sites and would have potential engineering or hydraulic constraints compared to the proposed sites. The second alternative examined four other RWTP sites, all of which would meet the objectives of the RWMP, but would in some way have more environmental constraints than the proposed Fleishhacker site. Other RWMP project-level alternatives examined but determined to be infeasible include: non-AWSS distribution system, increase recycled water demand, centralized storage reservoirs, and the Richmond Zone reservoir alternative.

There are no project-level alternatives to the GWMP since it is more of a conceptual, resource management plan compared to the RWMP. Project level alternatives to specific short-term activities are presented in the GWMP, but they would be considered as potential future projects, requiring additional investigations to determine feasibility, rather than as actual project-level alternatives to the project. These future projects, if determined to be feasible and proposed as a subsequent part of the GWMP, would be subject to further environmental review on a case-by-case basis.

H. AREAS OF CONTROVERSY

During development of the RWMP and GWMP, the Department of Public Works and Water Department have conducted on-going public participation activities, including presentations and discussions at neighborhood meetings, widespread distribution of newsletters, and meetings with individual City and state agencies (such as San Francisco Recreation and Park Department, Fire Department, and School District, and the California Department of Health Services and Regional Water Quality Control Board) plus a series of initial citywide scoping meetings for the environmental review process. Through these activities, the following areas of major public concern regarding implementation of the RWMP and GWMP have been identified:

RWMP

- AWSS system reliability and firefighter safety
- reservoir construction disruption
- public health

GWMP

- in-lieu recharge, coordination with other jurisdictions for groundwater management
- relationship of groundwater pumping and declining levels of Lake Merced
- location of Elk Glen Well and chlorination facilities

I. ISSUES TO BE RESOLVED

RWMP

System Management and Recycled Water Use

- DOHS formal approval of proposed treatment process.
- RWQCB issuance of Water Reuse Requirements, including monitoring and reporting requirements.
- Clarification of formal system management roles and responsibilities between DPW and SFWD for construction and operation phases.
- Development of specific Recycled Water User Agreements and onsite user management and monitoring procedures. Recycled water users are not all committed yet and unidentified users still to be determined.
- Whether or not to amend the City ordinance to remove the downtown area from the mandatory recycled water service area.
- Elimination of potential cross-connection risk between the AWSS and the potable water system.

Facilities Development

- Voter approval for use of public park/open space sites for RWTP and reservoirs.
- Alternative site selection for McLaren Park reservoir between Site 1 and Site 2 (Site 1 is the environmentally superior site.).
- Route determination for certain transmission pipelines and all distribution pipelines.
- Timing of distribution system development based on recycled water demand and need.

GWMP

In general, the GWMP sets a management direction and provides a decision making and implementation framework. The plan identifies a series of issues to be resolved, decisions to be made and actions to be taken in sequence. Details of implementation of many aspects of the GWMP still need to be developed. For any proposed groundwater production project or conjunctive use program, additional, detailed and site-specific investigation of feasibility and impact is required.

A chief groundwater resource management issue to be resolved involves management of Lake Merced. The GWMP outlines a program to develop an in-lieu recharge program in the vicinity of the Lake in order to reduce groundwater pumping and to allow natural recharge which is expected to result in raising the lake water level. The Public Utilities Commission adopted a policy in May 1995 requiring development of such a program and restoration of lake water levels. Implementation of the in-lieu program requires coordination with Daly City, San Bruno, and the California Water Service. The City has now initiated development of a voluntary groundwater management program with these entities.

INTRODUCTION

CHAPTER I
INTRODUCTION

A. PURPOSE

PROJECT OVERVIEW

The City and County of San Francisco (City), through the San Francisco Public Utilities Commission (PUC), has prepared a Recycled Water Master Plan (RWMP)[1] and a Groundwater Master Plan (GWMP).[2] As of August 1996, the PUC assumed jurisdiction over both the Clean Water Enterprise, formerly under the Department of Public Works (DPW), and the San Francisco Water Department (SFWD). The DPW was the original Project Sponsor of the RWMP, but currently the PUC is assuming project sponsorship of the RWMP; any reference to DPW used in this report should now be replaced with PUC. The SFWD was and continues to be the Project Sponsor of the GWMP.

The RWMP and GWMP are two companion planning documents intended to provide guidance for the long-term efficient use of the City's local water resources, including recycled (also known as reclaimed) water and groundwater. These plans have been prepared to comply with Article 22 of the *San Francisco Public Works Code*, known as the Reclaimed Water Use Ordinance. In addition to identifying long-term goals for the use of alternative water supplies, the plans include specific near-term projects that would be implemented to achieve these goals.

PROJECT LOCATION

The programs and projects that would be implemented under the RWMP and GWMP would directly affect areas located throughout the City and County of San Francisco and could indirectly affect areas in the broader Bay Area region, as well. As shown in Figure 1, the planning area for the RWMP and GWMP encompasses the entire City and County of San Francisco. Construction of all proposed facilities for both plans would be located within the City limits, and all aspects of the RWMP would be located within the City boundaries. The GWMP, however, is based on the physical boundaries of the groundwater system, and its influence would extend beyond the City and County lines. The approximate extended area of influence south of the City limits is shown on Figure 1.

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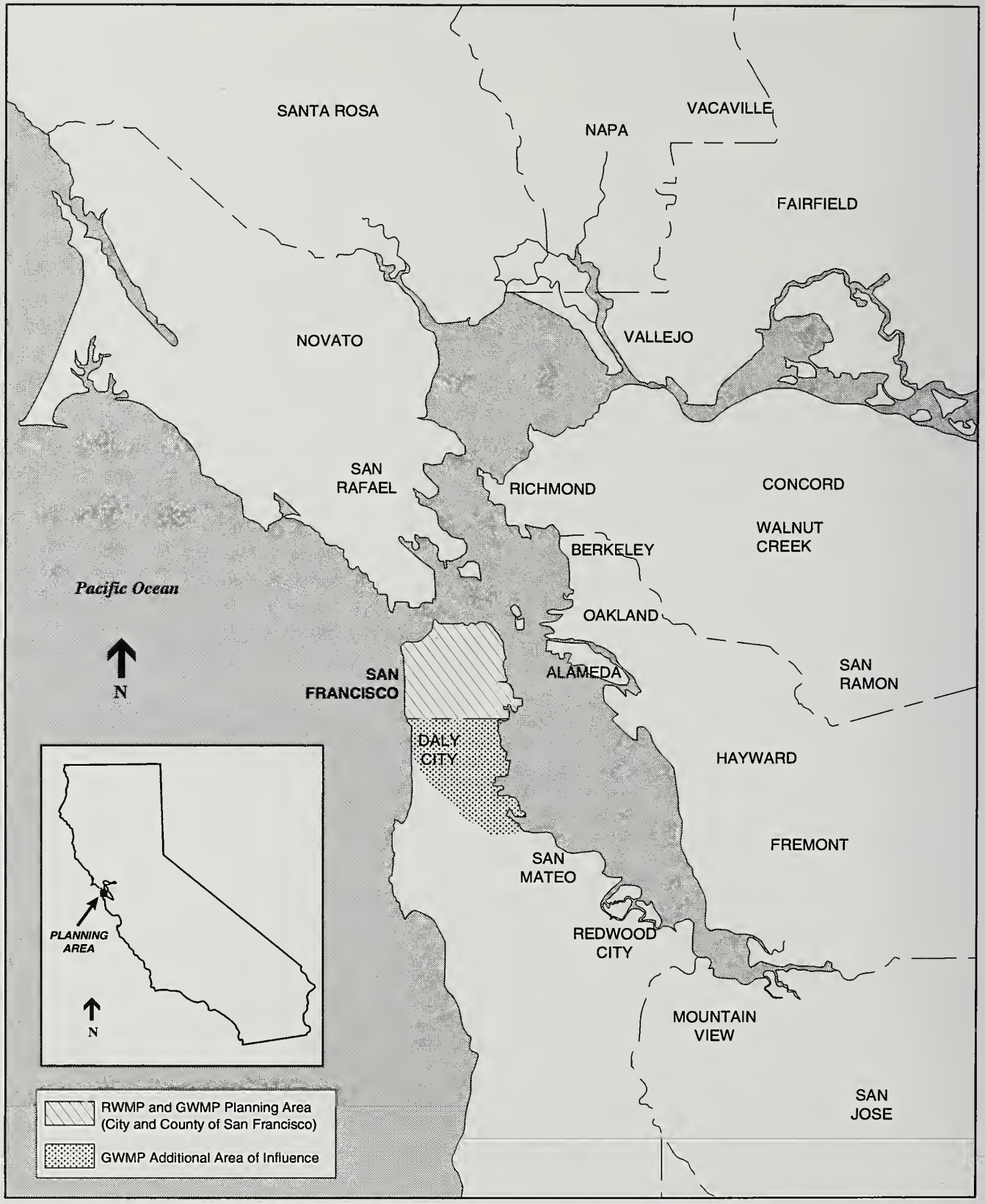
1 City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*. July 1996.
2 City and County of San Francisco, San Francisco Water Department, *Groundwater Master Plan*. July 1996.



SOURCE: Environmental Science Associates, 1995

SF RWMP / GWMP Program EIR ■

Figure 1
Regional Location

PURPOSE OF THE PLANS

The overall purpose of both plans is to maximize efficient use of the City's water resources, to improve water supply reliability during drought periods, and to preserve the highest quality water for potable uses. The purposes of the individual two plans are summarized below.

The purpose of the RWMP is to provide long-term guidance for the development and use of recycled water throughout the City and County of San Francisco. Recycled water, also known as reclaimed wastewater or reused water, is highly treated wastewater from the City's sewerage system that has undergone an additional level of treatment so that it is acceptable for various non-potable uses. Non-potable water is water that is not safe for human consumption, and non-potable uses are those such as irrigation, toilet flushing, and industrial cooling with minimal human contact. At present, the City is using potable water (water that is safe for human consumption) for a number of these non-potable uses. The RWMP addresses the potential for using recycled water in the City to the maximum extent feasible, identifies potential users, and outlines specific water recycling projects that can be implemented throughout the City. In addition, the proposed recycled water distribution system would be constructed to meet the standards of the existing Auxiliary Water Supply System (AWSS). The AWSS is a separate high-pressure water system operated by the San Francisco Fire Department (SFFD) that extends through some parts of the City (primarily the northeast area) and is used for fire protection. The recycled water distribution system would provide a water supply source for portions of the AWSS and would expand the fire fighting capabilities into the western and southern portions of the City.

The purpose of the GWMP is to provide guidance for the development and use of local groundwater and to incorporate groundwater as part of the overall long-term water supply plan for the City and County of San Francisco. The SFWD is responsible for maintaining a reliable, high-quality and affordable water supply for the City, and groundwater would serve to supplement the imported water supply from the SFWD system for either potable or non-potable uses. The GWMP outlines long-term strategies and short-term activities for increasing use of groundwater on a long-term basis, by centrally managing groundwater and using it conjunctively with surface water.

CEQA REVIEW

The San Francisco Planning Department, Office of Environmental Review has determined that the RWMP and GWMP are subject to the requirements of the California Environmental Quality Act (CEQA). Therefore, an evaluation of potential environmental effects of the RWMP and GWMP is required before any City decision can be made on the plans. On the basis of a preliminary review of the RWMP and GWMP, the City has determined that the plans may result in potentially significant impacts to the environment, and an Environmental Impact Report (EIR) is required to describe all potential environmental effects of the plans. No Initial Study to focus issues out of the EIR was prepared on the plans. Therefore, this EIR will discuss all of the topics listed in the Initial Study checklist. After environmental review of the RWMP and GWMP has been completed and the EIR on the plans has been certified by the San Francisco City Planning Commission, the RWMP and GWMP would be presented to the San Francisco Public Utilities Commission and the Board of Supervisors for a final decision as to the adoption of the proposed plans.

This document is a joint EIR on both the RWMP and GWMP. It is a public informational document for use by responsible governmental agencies and the public to identify and evaluate the potential physical environmental consequences of the proposed plans, to present mitigation measures to reduce or avoid potential environmental impacts, and to examine feasible alternatives to the plans. The information contained in the EIR will be reviewed and considered by the decision-makers before their decisions to approve, disapprove or modify the proposed plans.

B. PUBLIC PARTICIPATION

The City has conducted extensive public notification regarding the planning and development of the RWMP and GWMP. During 1992 and 1993, the DPW attended and conducted numerous informal neighborhood meetings at various locations in the City. In March 1993, the Planning Department sent a Notice of EIR Requirement for the RWMP to agencies, neighborhood groups and citizens, and a series of four formal scoping meetings was held from March 30 to April 1, 1993, to solicit oral comments from interested parties on the RWMP. In December 1994, the Planning Department sent a Notice of EIR Requirement for the RWMP and the GWMP to agencies, neighborhood groups and citizens to solicit comments concerning both plans. In addition, newsletters on the RWMP and GWMP were published and distributed in 1992, 1993,

1994, and 1995. All comments received from agencies and the public during this process have been considered in determining the scope of analysis presented in this EIR.

C. APPROACH TO THE EIR

The RWMP and GWMP are both comprehensive planning documents with long-term implications for the future use of recycled water and groundwater within San Francisco, and the two plans have many interrelated features. The plans are comprised of a series of long-term strategies and near-term projects that can be characterized as one large project. In accordance with the requirements of CEQA, the environmental analysis of the overall plans is presented in this document as a "program-level" of analysis, as part of a Program EIR. This is a general, system-wide level of analysis that addresses the potential environmental consequences of the overall objectives and conceptual designs of the plans, while also acknowledging the cumulative effects of the plans, as well as the individual projects outlined within the plans. The program-level analysis of potential environmental effects is applicable to the conceptual aspects of the plans. Subsequent activities which might be proposed pursuant to the plans would be examined relative to the information contained in this program EIR to determine whether additional environmental documentation must be prepared prior to a decision on those subsequent activities. If a later activity would have effects that were not examined in the program EIR, a new Initial Study would need to be prepared leading to either an EIR or a Negative Declaration. If the activity would have no new effects, then the project could be found to be within the scope of the project covered in the program EIR, and no new environmental document would be required.

This EIR also addresses a number of specific "project" components of the RWMP and GWMP. For both plans, there are detailed design and siting information for individual projects proposed for construction and implementation within the near term (about three to five years). The potential environmental effects of these project components are presented at a more detailed, "project-level" of analysis. This includes the analysis of specific construction techniques, siting constraints, and the operation of individual projects. The "project" aspects of this EIR are intended to fulfill all environmental review requirements for these specific projects, and would permit a final decision on these projects, assuming EIR certification and plan adoption.

D. ORGANIZATION OF THE EIR

This EIR has been organized to be useful to the general public, technical reviewers, and decision-makers to satisfy both short-term informational needs and long-term planning needs. It is presented in a single, large volume, which includes a summary, glossary, main body of the EIR, and selected technical appendices. Additional supporting information, as referenced throughout the EIR, is available as background reports or files at the Planning Department in the project file.

The EIR combines or separates sections on the RWMP and GWMP as appropriate to each chapter. Chapter II describes the Background on both the RWMP and GWMP. Chapter III presents the Project Description on the two plans in two distinct sections. Chapter IV describes the combined Environmental Setting for the planning area of both plans, with generalized regional or citywide setting descriptions as well as more detailed, site-specific descriptions for identified project sites for each plan. Chapter V includes separate sections for the impact assessment of the RWMP and GWMP, but also, where applicable, provides a combined discussion and analysis of the two plans taken as a whole. Chapter VI combines the discussion of Water Supply Effects and Growth Inducement Potential of the RWMP and the GWMP. Chapter VII presents the Mitigation Measures, combined for the two plans where applicable (in order to avoid redundancy) and separately as necessary for specific elements or sites of the individual plans. Chapters VIII and IX combine the discussions of Other Topics Required by CEQA and Alternatives.

BACKGROUND

CHAPTER II
BACKGROUND

A. NEED FOR AND OBJECTIVES OF THE RECYCLED WATER AND GROUNDWATER MASTER PLANS

NEED FOR THE PLANS

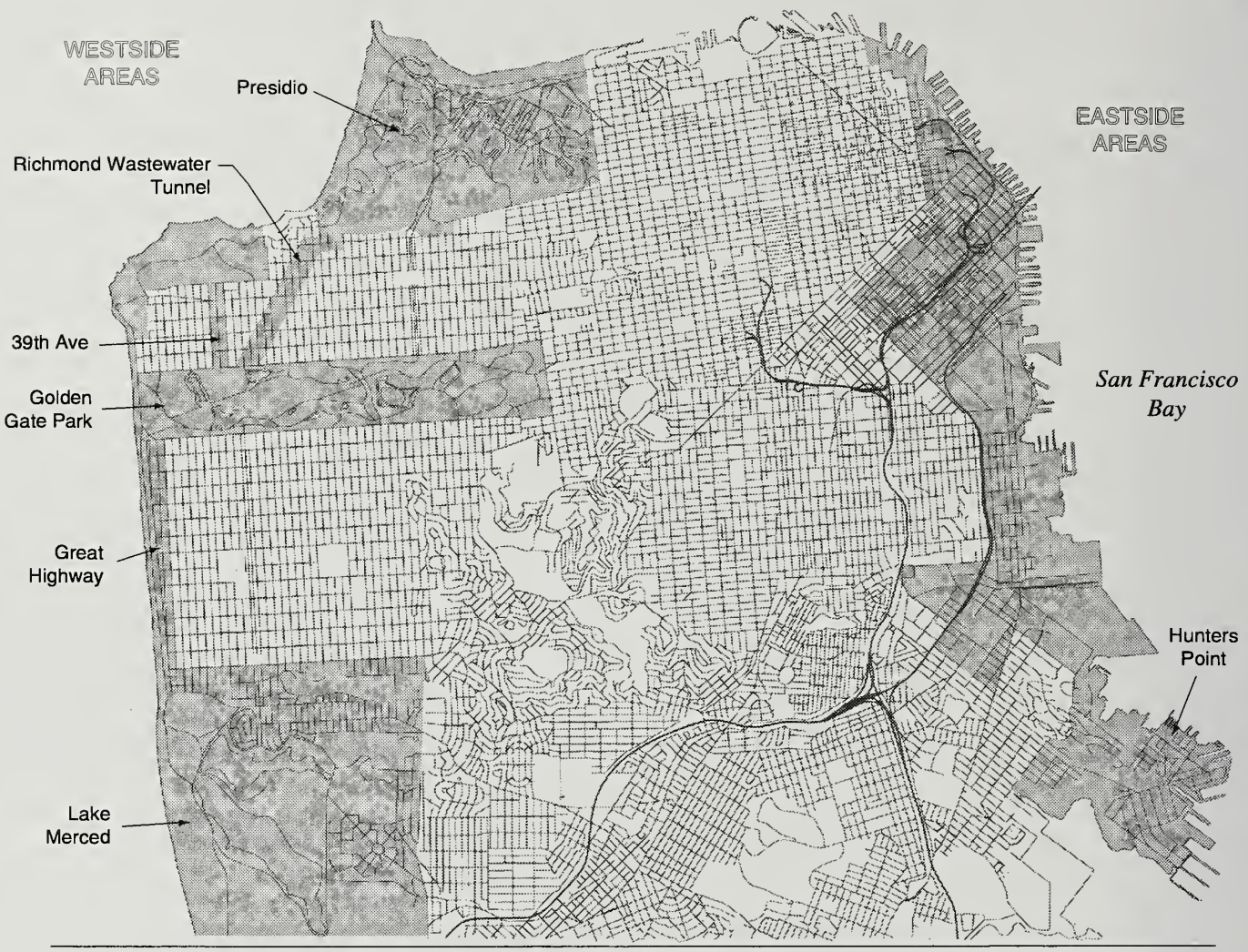
City Policy and Regulation

The proposed Recycled Water Master Plan (RWMP) and Groundwater Master Plan (GWMP) were prepared for the City and County of San Francisco (City) to comply with two companion ordinances and two resolutions adopted by the San Francisco Board of Supervisors in 1991, Ordinances 390-91 and 391-91 and Resolutions 389-89 and 612-91. The Reclaimed Water Use Ordinance and water reclamation/groundwater development resolutions mandated that groundwater and recycled water be developed for maximum beneficial use wherever reasonable. The ordinance and resolutions mandated the following actions:

- The San Francisco Water Department (SFWD) should prepare a Groundwater Master Plan detailing groundwater development.
- The San Francisco Department of Public Works (DPW) should prepare a Recycled Water Master Plan detailing recycled water development.
- These plans should be coordinated to help expand the use of groundwater and recycled water by all water consumers in San Francisco.

Figure 2 presents the non-potable water usage areas subject to the requirements of the water reclamation ordinances and resolutions.

The Board of Supervisors has also enacted several resolutions and ordinances designed to conserve potable water for drinking, cooking and other essential uses. The resolutions and ordinances dictate policies to encourage water conservation, to improve groundwater management and utilization, and to develop a program for water reclamation (referred to herein as water recycling). There are specific program and project requirements for water conservation, such as types of plumbing fixtures in residential and commercial buildings, restrictions for water use in landscaping, and mandatory use of non-potable water for dust control and soil compaction. Relevant water resolutions and ordinances adopted by the Board of Supervisors are summarized



SOURCE: City and County of San Francisco, *Recycled Water Master Plan*, Draft, July 1996

SF RWMP / GWMP Program EIR ■

Figure 2
Non-Potable Water Use Areas

in Table 1. These efforts are part of an overall strategy for water use and conservation to minimize the effects of future droughts, to develop alternative sources of water for non-potable uses, and to make efficient use of the most pure drinking water.

Water Shortage and Drought Planning

From 1987 to 1993, water conservation was necessary for all residents and businesses in San Francisco due to six continuous years of below-average rainfall.[1] The extended drought depleted reservoir supplies and may have caused overdrafting of groundwater, further depleting available water supplies. Drought conditions also affected wildlife and habitat as well as hydroelectric energy production. The water shortage during this period demonstrated the vulnerability of the City's water supply, and showed the need for further development of supplemental recycled water and groundwater supplies to help relieve water shortages during future drought conditions.

Due to the limited statewide water supplies, existing and future water supply needs are being evaluated regionally and throughout the state. Also in response to the recent drought and statewide water shortages, the State Water Resources Control Board (SWRCB) is currently conducting Bay-Delta Hearings to evaluate water usage within the San Francisco Bay and Delta Estuary. The purpose of the hearings is to develop a Water Quality Control Plan which will protect all beneficial uses of the San Francisco Bay and Delta Estuary, including urban, agricultural, and wildlife/habitat uses. As part of these hearings, water diversions from the Delta are under review to determine their impact and sustainability. All water users must demonstrate that water resources are being used efficiently. Water recycling planning has become an integral part of the Bay-Delta planning effort and many cities, including San Francisco, have presented their commitment to water recycling at the Bay-Delta hearings.

Water Demand

Water supply planning conducted by the City has indicated that there are limitations in the existing water supply and transmission system that may cause problems in meeting future water demand projections beyond the year 2010.[2,3] Although the City's Hetch Hetchy water supply

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1 San Francisco, City and County, 1993. Response to Data Request Concerning FERC Opinion 4210. Public Utilities Commission and Hetch Hetchy Water and Power Department, June 8.

2 ibid.

3 California Department of Water Resources, 1994, Bulletin 160-93, California Water Plan Update, Volume 2, October.

TABLE 1: SAN FRANCISCO BOARD OF SUPERVISORS WATER POLICIES

Policy Type / Title	Description
Policy Development	**Board-adopted policy which directs or requires the development of future policies to address water management issues.**
Resolution 707-91	Directs the Public Utilities Commission to enter into an Urban Water Conservation Memorandum of Understanding with the California Urban Water Conservation Council.
Program Development	**Board-adopted policies which mandate an activity or action.**
Ordinance 392-90	Requires all new buildings and all modified water drainage systems to install toilets and urinals that use 1.6 gallons or less of water per flush.
Ordinance 175-91	Requires contractors to use recycled (reclaimed) wastewater for dust control and soil compaction.
Ordinance 92-91	Requires review of water use for landscaping in new development.
Ordinance 185-91	Requires plumbing fixture retrofit in multi-family residential buildings.
Ordinance 346-91	Requires plumbing fixture retrofit in single-family residential buildings.
Ordinance 359-91	Requires plumbing fixture retrofit in commercial buildings, including tourist hotels and motels.
Project Development	**Board-adopted policies pertaining to long-range management of water resources.**
Ordinances 390-91 and 391-91	Mandates the installation of dual plumbing, the use of recycled (reclaimed) water when it is available and the development of a Water Reclamation Master Plan.
Resolution 389-89	Mandates the development of a management plan to use 8 mgd of non-potable groundwater.
Resolution 612-91	Mandates the development of a water reclamation and groundwater conjunctive use plan to use surface water and groundwater.

SOURCE: San Francisco Department of Public Works, 1993.

system (described below) was designed with a capacity of over 400 million gallons daily (mgd), but as currently constructed, it can provide 300 mgd. The results of the six-year drought indicated that the existing system has a safe yield capacity of about 242 mgd in order to accommodate the worst-case dry periods without jeopardizing the supply.[4] Supplemental water supplies from local Bay Area watersheds and groundwater sources are highly variable and dependent upon seasonal precipitation. Projected water demands for the City and other water users supplied by the SFWD indicate water demand will increase from about 242 mgd in 1994 to about 280 mgd in the year 2010.[5]

OBJECTIVES

The City and County of San Francisco prepared the RWMP and GWMP to provide long-term guidance for the development and use of alternative water resources to augment the City's current water supply from the Hetch Hetchy system and local reservoir system. The goal of both plans is to maximize the efficient use of available water resources to ensure future availability of water supplies of suitable water quality for appropriate uses.

The DPW and the SFWD are jointly responsible for the development and implementation of both plans. DPW has primary responsibility for development of the RWMP and construction and operation of the recycled water facilities, while the SFWD has primary responsibility for development of the GWMP and its implementation. SFWD would be responsible for the long-term implementation of water distribution aspects of both plans. The shared objectives of both the RWMP and GWMP are:

- Coordinate management and conservation of the City's water supply resources, including surface water, groundwater and recycled water;
- Improve water supply reliability for the City, particularly during drought periods;
- Improve reliability and expand the fire protection system within the City;
- Preserve the high quality Hetch Hetchy system water supply for potable uses; and
- Maximize the use of recycled water within the City at a reasonable cost.

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4 City and County of San Francisco, *San Francisco Water and Power, A History of the Municipal Water Department and Hetch Hetchy System*, 1993.

5 San Francisco, City and County, 1993. Response to Data Request Concerning FERC Opinion 4210. Public Utilities Commission and Hetch Hetchy Water and Power Department, June 8.

B. DEVELOPMENT OF MASTER PLANS

IDENTIFICATION OF POTENTIAL NON-POTABLE AND POTABLE WATER USERS

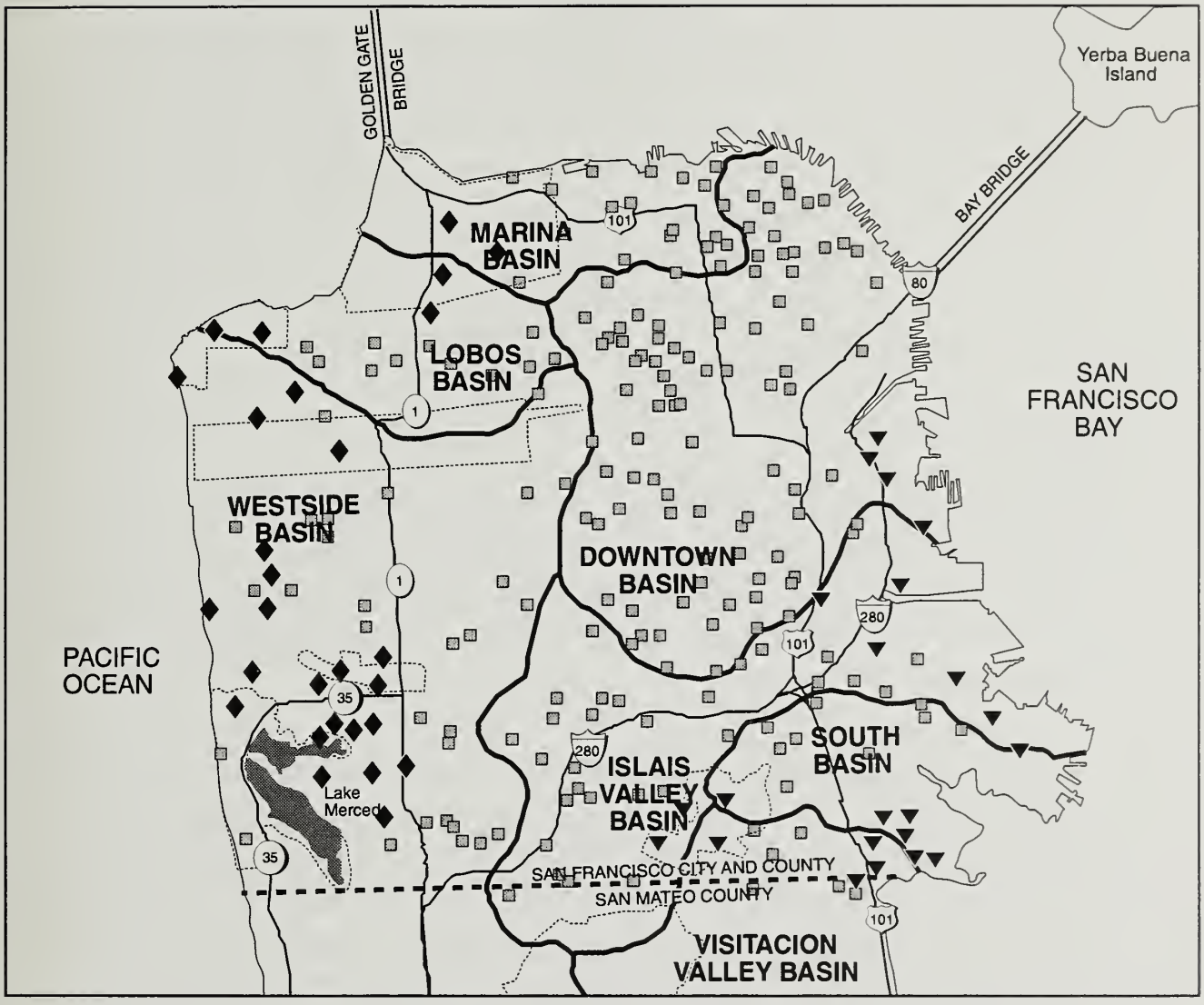
The first step in developing the RWMP was the identification of all major non-potable water uses in the City that could potentially be served by recycled water or non-potable groundwater. In San Francisco, the main categories of non-potable water uses for which recycled water can be used include: landscape irrigation (parks, golf courses, playgrounds, plazas), toilet flushing, office building cooling systems, fire fighting, and industrial uses. Over 250 individual non-potable water users in the City were identified, with about two-thirds of the demand attributable to landscape irrigation. Figure 3 shows the location of the major non-potable water users in the City. From among the identified non-potable water users, the targeted recycled water users were determined based on the following criteria:

- Users located in the required reclaimed water use zones defined in the City's Reclaimed Water Use Ordinances (see Figure 2, p. 8);
- The level of water demand for each user;
- The cost to develop distribution infrastructure; and
- Users which could be served by a recycled water distribution system designed to San Francisco Fire Department (SFFD) standards for the Auxiliary Water Supply System (AWSS). This would expand the existing fire protection system.

The SFFD requested that in the downtown area, the AWSS which is used for fire fighting, not be used to distribute recycled water. The SFFD has indicated that adding new connections to this older part of the system in the densely developed downtown area would reduce the fire protection system's reliability and thereby increase the fire hazard risk.

The potential non-potable water users targeted to be served by recycled water are highlighted on Figure 3. The users selected to initially receive recycled water are located along the westside of the City. Specific proposed recycled water users and uses are identified in Section III.A, RWMP Project Description (pp. 29 to 69).

The remaining non-potable water users that are not proposed to be served by the recycled water system could potentially be served by groundwater, particularly where the groundwater is determined to be non-potable (such as the downtown area).



Parks (see Fig. 2-4 for names)

Phase 1 recycled water users

Phases 2 and 3 recycled water users (may recieve groundwater until Phase 3)

Other potential non-potable water users.

Groundwater Basin Boundary

N

0 1.0

APPROX. SCALE IN MILES

SOURCE: Data from City and County of San Francisco, *Recycled Water Master Plan*, July 1996; figure from *Groundwater Master Plan*, Draft, July 1996

SF RWMP/GWMP Program EIR ■

Figure 3
Potential Non-Potable Water Users

In developing the GWMP, one important component was the identification of major potable water users in the City to determine the most economical way to meet potable water demand with the fewest number of wells, since groundwater can serve both potable and non-potable users. Major potable water users were defined as those using more than 10 acre-feet per year (ac-ft/yr) or about 9,000 gallons per day on an average day. Most large potable water users are concentrated within the downtown area, and most users are currently served by imported surface water from the SFWD. However, several large users are located on the westside of the City, such as Golden Gate Park, the Zoo, and the Presidio, and many of these users are currently using groundwater. Figure 4 shows major potable water users in the City, including those that currently use groundwater.

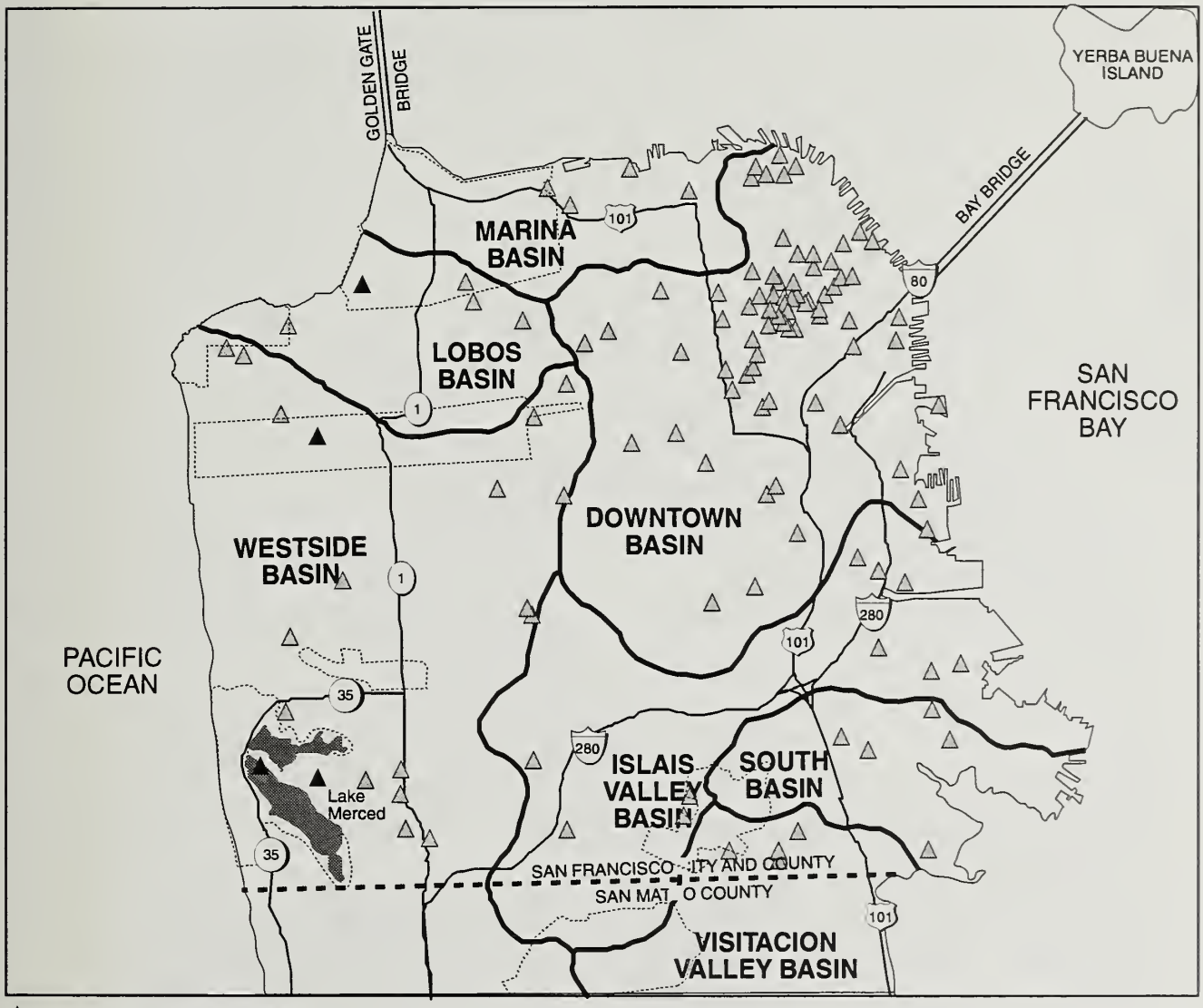
PLAN DEVELOPMENT

Following identification of the non-potable and potable users, the City then determined the highest and best use for potable groundwater and the non-potable water users that could be served cost-effectively with recycled water. The City then proceeded with further development of the RWMP and GWMP to identify specific programs and infrastructure projects that address the targeted users.

In the long term, the shared objective of the RWMP and GWMP is to integrate the use of surface water, recycled water and groundwater to meet Citywide water supply demands for both potable and non-potable users. The specific water source for individual users would depend on the water quality requirements, the location of the user, and the availability or accessibility of the water source. Figure 5 (p. 16) depicts two possible future scenarios showing typical users of surface water, recycled water, and groundwater and the integration of the various water supply sources. Although not depicted in Figure 5, groundwater could be of sufficiently high quality that it could be added to the City's drinking water distribution system. This is described in more detail below in both the project description and impact analysis for the GWMP.

RWMP DEVELOPMENT

The RWMP has been developed by DPW in stages starting in 1990. The first stage consisted of the following: a market analysis to identify potential users of recycled water and to determine demand and quality requirements; a review of relevant regulations and determination of the suitability of the recycled water quality for identified potential uses; and the preliminary identification of potential water recycling projects in the City. The second stage was an



▲ = *Major Groundwater User*

△ = *Major Surface Water User*

NOTE: Large users are those users identified from Water Department records who use more than 10 acre-feet (3.26 million gallons) of water per year.

Sources: San Francisco Water Department, City Distribution Division, Pitometer Associates (1961-1989)

SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

SF RWMP/GWMP Program EIR ■

Figure 4
Major Potable Water Users

SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

Figure 5
Integrated Use of Surface, Recycled, and Ground Water-Typical Scenarios

economic analysis of preliminary alternatives and the development of recommended alternatives. The third stage was the assessment of project support from various state and city agencies. The fourth stage of the process included preliminary environmental assessment of potential sites and screening of final alternatives. DPW was assisted in this process by a Recycled Water Steering Committee and Peer Review Group, which consisted of member of various City agencies, citizen representatives and Bay Area technical experts. DPW published the Draft RWMP in October 1992. The final stage involved the selection and refinement of the Apparent Best Alternative (ABA) project, which was developed in conjunction with the GWMP and incorporated into the RWMP in 1995 to 1996.

Over 30 preliminary system alternatives were developed based on alternative distribution systems, storage systems and treatment plant sites. Those alternatives examined a variety of siting options for the various facilities as well as alternative engineering approaches for system development. The alternatives were then screened based on engineering feasibility, cost-effectiveness, and a preliminary assessment of environmental issues. On the basis of this analysis, preferred sites for the various facilities were selected, and the recommended Apparent Best Alternative project was developed and refined. Section IX.C (p. 517) provides more discussion of the alternatives screening and analysis process.

GWMP DEVELOPMENT

Development of the GWMP was begun by SFWD in 1993 as a series of investigations to identify existing water supply and demand conditions within the City, regulatory requirements, and other factors affecting groundwater management. A review of previous work and data compilation was conducted to develop an overview of the known hydrogeologic characteristics of the groundwater basins that occur in the study area. This information was used to develop and conduct a groundwater data collection and field investigation, focusing on areas of the City with the greatest potential for groundwater development. Additional studies and modeling were also conducted on the potential for subsidence, saltwater intrusion and changes in Lake Merced water levels resulting from groundwater use.

These studies and investigations identified potential groundwater development projects, and also indicated where there is a lack of information and data regarding hydrogeologic conditions and water quality for the various groundwater basins which exist, in whole or in part, within the City. Using these background studies, the SFWD, together with a Groundwater Steering Committee comprised of members of various City agencies as well as SFWD water customers outside of

San Francisco, developed the proposed GWMP. The GWMP establishes an overall framework for management, development and use of groundwater, with the identification of goals, long-term strategies and specific short-term activities.

C. REGULATORY FRAMEWORK

The management of recycled water and groundwater resources is regulated and guided by a variety of federal, state, and local regulations, standards and policies. The key regulations applicable to the RWMP and/or the GWMP are summarized in Table 2. The unifying goal of these regulations is to ensure that water resources (surface, ground, and recycled water) are managed in such a way as to protect public health while maintaining their ecological and water supply values.

The two overarching laws governing water quality in California (excluding drinking water quality) are the federal Clean Water Act and the California Porter-Cologne Water Quality Control Act (Porter-Cologne). Porter-Cologne assigned authority for control and protection of surface and groundwater quality to the State Water Resources Control Board and Regional Water Quality Control Boards. The San Francisco Regional Water Quality Control Board is responsible for issuing the master permit which allows the City to conduct water recycling. Porter-Cologne authorized the California Department of Health Services to set criteria for recycled water production and use to protect public health. These standards are contained in Title 22, Division 4 of the California Code of Regulations. DOHS also established drinking water quality standards in Title 22, as authorized by the California Safe Drinking Water Act. The state Groundwater Management Act, AB3030, authorized local agencies that provide water service to implement groundwater management plans. The regulations and authorities outlined in Table 2 are discussed in greater detail in Appendix B, p. B-1.

D. EXISTING WATER SYSTEMS OVERVIEW

SAN FRANCISCO WATER DEPARTMENT SYSTEM

High-quality potable water is currently used throughout the City for all residential, commercial, and industrial uses, including non-potable uses such as irrigation, toilet flushing, industrial process water and fire fighting. The City receives approximately 80% of its water supply from the Hetch Hetchy water system from the Sierra Nevada mountains and the balance from local Bay Area watersheds (see Figure 6, p. 22). The local watershed system includes water from reservoirs in Alameda County and the Peninsula that is treated at one of two water filtration plants before

TABLE 2: SUMMARY OF KEY FEDERAL AND STATE WATER QUALITY REGULATIONS

REGULATIONS/LAWS	DIRECTIVE	KEY ISSUES	AGENCY	CITATION
Clean Water Act/Water Pollution Control Act (federal law)	Objective is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" to make all surface waters "fishable" and "swimmable." Requires states to establish water quality standards to protect designated uses for all navigable waters of the nation. Established the National Pollutant Discharge Elimination System (NPDES) permitting program, which regulates discharges to surface water .	• Surface Water	US EPA delegated to SWRCB, RWQCBs	P.L. 92-500 1972; amended by Water Quality Act of 1987 P.L. 100-4
Porter-Cologne California Water Quality Control Act (state law)	Designates primary responsibility for coordination and control of water quality to SWRCB and Regional Boards. Authorizes SWRCB to adopt Water Quality Control Plans (WQCPs or Basin Plans) for surface waters for which water quality standards are required by the Federal Clean Water Act, and RWQCBs to adopt WQCPs for their respective regions. Designates SWRCB responsible for formulating and adopting state policy for water reclamation, and DOHS responsible for establishing statewide reclamation criteria to ensure that the use of reclaimed water will not be detrimental to public health. Designates RWQCBs responsible for implementing the NPDES program/permitting of wastewater discharges, including issuance of waste discharge requirements (WDRs), water reuse requirements, and master reclamation permits (the latter two are issued in consultation with the DOHS). Designates SWRCB and RWQCB responsible for statewide groundwater planning and protection programs.	• Surface Water • Water Recycling • Public Health • Groundwater	SWRCB and RWQCBs (and DOHS regarding water reclamation)	CA Water Code, Division 7, Chapters 1-17, Sections 13000-14050
Wastewater Reclamation Criteria (Title 22) (state regulation)	Sets forth uniform water quality standards and treatment reliability criteria for water reclamation operations, according to proposed use (restricted or unrestricted use). Proposed revisions expand allowable uses and increase the flexibility regarding method of meeting water quality criteria. (See Appendix Tables B-1 and B-2.)	• Water Recycling • Public Health	DOHS, or delegated to local health agency	CCR, Title 22, Division 4, Chapter 15, Articles 1-19, Sections 64432.2-64501
Guidelines for Use of Recycled Water (state guidelines)	Sets forth reclaimed water application and management guidelines for reclaimed water uses, including landscape irrigation, agricultural application, and impoundment (see Appendix Table B-2). DOHS has also produced separate guidelines for other reclaimed water uses, including construction and groundwater recharge.	• Water Recycling • Public Health	DOHS	DOHS Guidelines, June 10, 1988

TABLE 2: SUMMARY OF KEY FEDERAL AND STATE WATER QUALITY REGULATIONS (Continued)

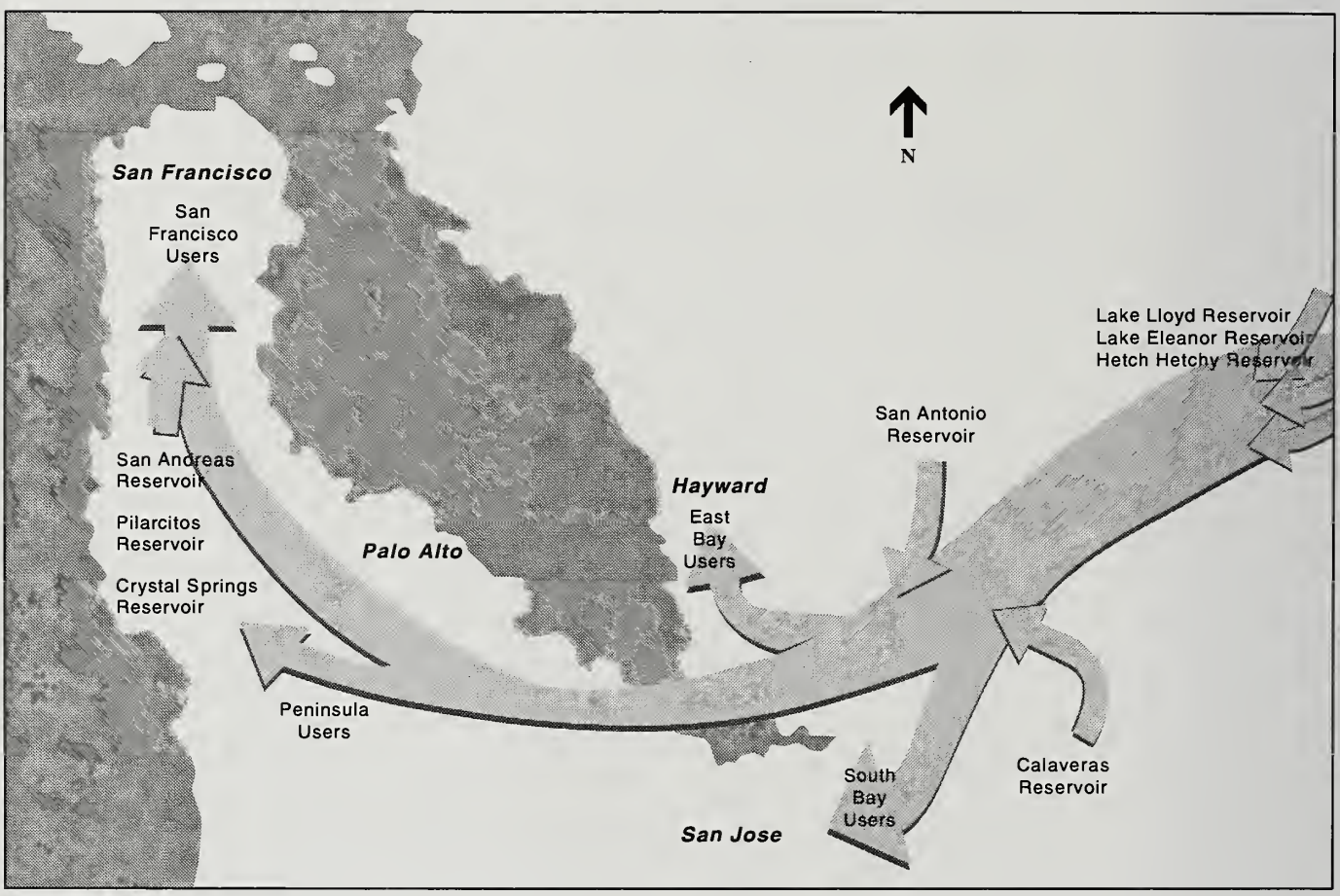
REGULATIONS/LAWS	DIRECTIVE	KEY ISSUES	AGENCY	CITATION
Federal Antidegradation Policy	Mandates that each state have an "antidegradation" policy for surface waters which must be consistent with the following: (1) Existing instream water uses shall be maintained, (2) Water bodies of quality exceeding levels necessary to support existing beneficial uses are to be protected. However, limited quality degradation may be allowed if necessary to accommodate important economic or social development, and (3) Quality of waters which constitute an outstanding national resource must be maintained.	• Surface Water • Water Recycling	SWRCB, RWQCB	CFR; Book 40, Part 131, Subpart B, Section 131.12
State Antidegradation Policy	Establishes a general principle of nondegradation, with flexibility to allow change in water quality deemed to be in the best interest of the state, if beneficial uses are not unreasonably affected. Requires that WQCPs adopted by the SWRCB include minimum requirements for reclaimed water quality, and contains general principles intended to implement the state's intent to maximize beneficial water reuse.	• Surface Water • Water Recycling	SWRCB, RWQCB	SWRCB Resolution No. 68-16
Regulations Relating to Cross Connections (Title 17) (state regulations)	Requires that a water supplier protect the public water supply from contamination by implementation of a cross connection control program. Specifies minimum standards for type of backflow prevention devices according to degree of potential hazard at user site. Requires that all reclaimed water pipes installed above or below ground after 1993 be colored purple or distinctively wrapped with purple tape.	• Water Recycling • Public Health	DOHS, or water supplier, local health agency, or other delegated agency	CCR, Title 17, Chapter 5
Groundwater Management Act (AB3030) (state law)	Authorizes local agencies that provide water service...to adopt and implement a groundwater management plan, and to impose fees and assessments for the purpose of groundwater management (fees must be approved by election). A voluntary method of groundwater management compared to basin adjudication or formation of a water replenishment district requiring enactment of state enabling legislation.	• Ground-water	Local water agencies/ private purveyors	CA Water Code, Sections 10750 et. seq.
Safe Drinking Water Act (federal law)	Mandates EPA to establish national primary and secondary drinking water regulations, by setting Maximum Contaminant Levels (MCLs). Primary standards intended to protect public health. Secondary standards intended to protect public welfare. Established Wellhead Protection Program to protect groundwater sources of drinking water from contamination.	• Drinking Water • Public Health	US EPA, local water suppliers	P.L. 93-523, enacted 1974; amended 1986 P.L. 99-339

TABLE 2: SUMMARY OF KEY FEDERAL AND STATE WATER QUALITY REGULATIONS (Continued)

REGULATIONS/LAWS	DIRECTIVE	KEY ISSUES	AGENCY	CITATION
Safe Drinking Water Act (state law)	Requires DOHS to administer laws relating to drinking water regulation, including setting and enforcing both federal and state drinking water standards, administering water quality testing programs, and administering permits for public water system operations.	• Drinking Water • Public Health	DOHS	CA Health and Safety Code, Division 5, Chapters 7-9, Sections 4037-4095, Enacted 1976, amended 1989
Drinking Water Quality Regulations (federal regulations)	Establish national primary and secondary drinking water standards; the stricter state MCLs (see below) are enforced in California.	• Drinking Water • Public Health	US EPA	CFR, Book 40, Part 131, Subpart B, Sections 131.10-131.13
Drinking Water Quality Regulations (Title 22) (state regulations)	Under the authority of the State Drinking Water Act, the DOHS established primary and secondary drinking water standards for public water systems, including minimum water quality monitoring of water delivered to consumers, pursuant to Sections 4010-4037 of the Health and Safety Code.	• Drinking Water • Public Health	DOHS	CCR, Title 22, Division 4, Chapter 15, Articles 1-19, Sections 64432.2-64501

USEPA U.S. Environmental Protection Agency
SWRCB State Water Resources Control Board
RWQCB Regional Water Quality Control Board
DOHS Department of Health Services
P.L. Public Law
CCR California Code of Regulations
CFR Code of Federal Regulations
WQCP Water Quality Control Plan, also known as Basin Plan
MCL Maximum Contaminant Level

SOURCE: Environmental Science Associates, 1995; compiled from laws and regulations.



SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

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Figure 6
San Francisco Water System

delivery to the City or other communities. Operated by the SFWD, the system also provides wholesale water for 30 suburban communities located on the Peninsula and in the East and South Bay areas. The SFWD currently serves approximately 2.3 million people in Alameda, Santa Clara, San Mateo and San Francisco counties.

The current SFWD system does not include any groundwater; all of the water delivered to its service area is surface water either from the Hetch Hetchy system or from local reservoirs. However, some groundwater is pumped and used at certain locations within the service area, including San Francisco. Some of the suburban users (Alameda County Water District, Daly City, San Bruno, Mountain View, and California Water Service) have an extensive system of developed groundwater that provides the base water supply that is supplemented with purchased water from the SFWD, while in other cases, the purchased supply from the SFWD is augmented with groundwater.

Hetch Hetchy System

The Hetch Hetchy water system was authorized under the Raker Act in 1913, which granted water and power resource rights-of-way on the Tuolumne River in Yosemite National Park and Stanislaus National Forest to the City and County of San Francisco. The Act permitted the City to construct, operate and maintain dams, reservoirs, power plants and other facilities necessary to develop water supplies and hydroelectric power. The system began delivery of Tuolumne River water to San Francisco in 1934, and has continued to operate without interruption for 60 years. The water system includes reservoirs, dams, and transmission facilities stretching from the Sierra Nevada Mountains, across the San Joaquin Valley, the Coast Range and San Francisco Bay, to the City, peninsula and surrounding suburban communities.

The Hetch Hetchy water supply originates in the Sierra Nevada mountains, in the Hetch Hetchy Reservoir, which was originally created by the O'Shaughnessy Dam. The reservoir is supplied primarily by virtually contaminant-free-snowmelt from a watershed of 459 square miles located entirely in Yosemite National Park. From the reservoir, water flows west through a series of covered tunnels into three San Joaquin Valley pipelines. These pipelines are designed to transport 300 mgd of water across the valley, where the water receives in-line treatment for pH control and disinfection. The water then goes through the Coast Range Mountain tunnel, and across the East and South Bay for distribution to the City of San Francisco and other communities.

Although primarily used for domestic supply in the Bay Area, Hetch Hetchy Reservoir water is also used to fulfill the City's contractual obligations to the Turlock and Modesto Irrigation Districts, to the Department of the Interior for maintenance of instream flows in the Tuolumne River below the O'Shaughnessy Dam, and to generate hydroelectric power.

SAN FRANCISCO FIRE DEPARTMENT - AUXILIARY WATER SUPPLY SYSTEM

The AWSS is a separate water supply system located in the City and County of San Francisco which is currently used to provide water for fire-fighting needs. The AWSS is concentrated in the downtown area of the City, with some extension to the southeast and central parts of the City, as shown in Figure 7. The AWSS was built in 1912 in response to the fire that followed the 1906 earthquake. It has recently (in the late 1980s and continuing into the 1990s) been expanded into parts of the South Bayshore and West of Twin Peaks areas. The system is operated by the SFFD and consists of reservoirs and a network of high-pressure pipelines, cisterns, and saltwater pumping stations. The distribution pipelines convey non-potable water to hydrants located in different parts of the City, primarily in the Downtown, Mission and South of Market areas. The water supply to the AWSS is primarily potable water from the SFWD, but because there is inadequate disinfection within the AWSS, the water at the AWSS hydrants is non-potable. Bay saltwater has also been used as an alternate water supply for the AWSS. Saltwater used in the AWSS during the drought caused millions of dollars in damage due to corrosion. The SFFD maintains the AWSS at high pressures of up to 300 pounds per square inch (psi) for use in fighting large fires or fires located near the AWSS hydrants, compared to SFWD's system, which is maintained at pressures of 40 to 90 psi typically used for water distribution.[6]

GROUNDWATER USE IN SAN FRANCISCO

Historically, groundwater was the major source of water for the City, with about 700 private and public wells producing about 8.5 mgd in 1913, with very few public wells providing production wells for public use.[7] Today, there are about 40 active wells producing about 4 mgd of groundwater. Groundwater is used to meet about 5 percent of the current water demand within the City, with the remaining water demand met by imported water from the Hetch Hetchy system.

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6 Jennifer L. Long, James M. Montgomery Consulting Engineers, Inc., Memorandum to File 1064.0060/6.9 regarding Reclamation Master Plan AWSS Cross Connection Prevention and Remediation Procedures, November 27, 1991.

7 Bartell, M.J., *Report on the Underground Water Supply of San Francisco County*, prepared under the direction of M.M. O'Shaughnessy, May 1913.

SOURCE: City and County of San Francisco, *Recycled Water Master Plan*, Draft, July 1996

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Figure 7
Existing Auxiliary Water Supply System (AWSS)

Existing wells in the City extract groundwater mainly from the westside, downtown and northwest areas of the City. Along the westside of the City, groundwater is used mainly for municipal and irrigation uses, including golf courses in the Lake Merced area, cemeteries and nurseries, and San Francisco Recreation and Park Department uses including Golden Gate Park, the San Francisco Zoo, and Stern Grove. In the downtown area, groundwater is currently pumped regularly for dewatering operations for building foundations, other underground structures (such as BART) and construction sites; most of this pumped groundwater is routed directly to the sewer. The National Park Service at the Presidio in the northwest portion of the City pumps groundwater for potable purposes. There are few active wells in other parts of the City.

E. EXISTING WASTEWATER SYSTEM OVERVIEW

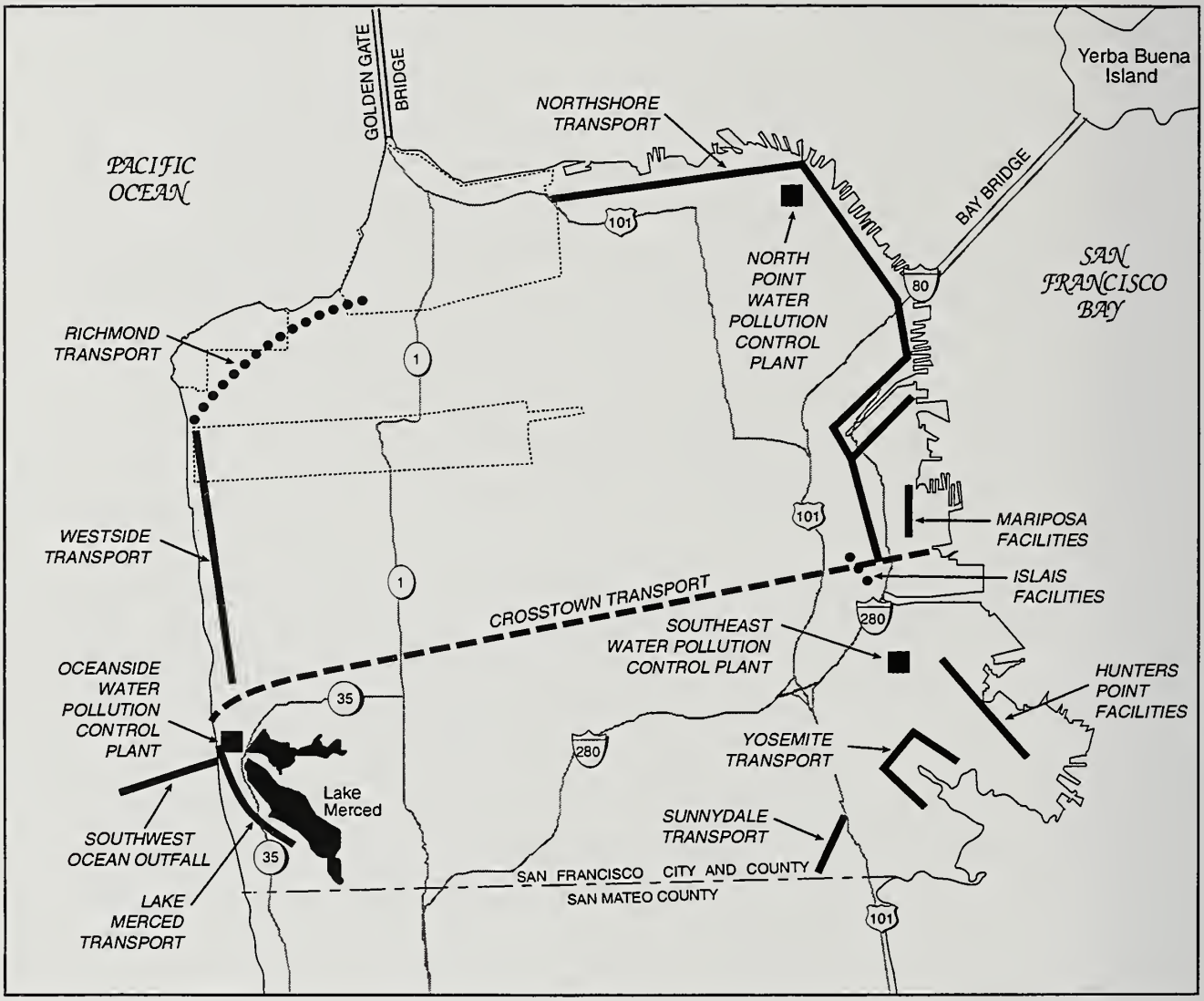
EXISTING COLLECTION, TREATMENT AND DISPOSAL SYSTEM

The City's wastewater collection, treatment and disposal system consists of a combined sewer system (which collects both sewage and stormwater), three water pollution control plants (WPCP), and outfalls to San Francisco Bay and the Pacific Ocean. The collection and conveyance system consists of approximately 900 miles of various sizes of underground sewer pipes and transport structures located throughout the City. Two of the City's water pollution control plants, the Southeast WPCP and Oceanside WPCP, operate year-round, while the third plant, the North Point WPCP, operates only during wet weather. Ultimate disposal of treated wastewater effluent is currently through outfalls to both the San Francisco Bay and the Pacific Ocean.

The Oceanside WPCP, located on the Great Highway south of the San Francisco Zoo, replaced the Richmond-Sunset WPCP in Golden Gate Park which provided wastewater treatment from 1938 to 1994. The Oceanside plant serves the westside of the City with a design average dry-weather capacity of 17 mgd and a peak wet-weather flow of 65 mgd. It provides primary and secondary-level treatment prior to discharge to the Pacific Ocean through the 4.5-mile Southwest Ocean Outfall. The Southeast WPCP is located on the eastside of the City, on Jerrold Avenue between Quint Street and Phelps Street. It treats all of the eastside sewage flows during dry weather. Secondary-treated dry-weather effluent from the Southeast WPCP is discharged through the Pier 80 Outfall, located east of Pier 80, to San Francisco Bay. Currently, the City discharges a total of about 87 mgd of treated wastewater during dry weather to San Francisco Bay and the Pacific Ocean. The North Point WPCP, located on Bay and Kearny streets at The

Embarcadero, is a primary treatment facility that operates only during wet weather. Primary-treated wet-weather effluent is discharged to San Francisco Bay through outfalls located under Pier 33 and Pier 45.

The City's wastewater collection, treatment and disposal system has been continuously developed, expanded, and improved since it was first built in 1850 to accommodate the needs of the City. Under the current Master Plan for Wastewater Management, adopted in 1971, the City's sewerage system has been undergoing a series of improvement projects on the eastside and westside of the City that are designed to reduce the discharges of untreated sewage to San Franciso Bay and the Pacific Ocean. The completion of all projects within the Wastewater Master Plan, except for ultimate discharge of bayside flows, is scheduled for 1997. Figure 8 depicts the various projects in the Wastewater Master Plan.



SOURCE: Clean Water Enterprise, 1996

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Figure 8
San Francisco Wastewater
Master Plan System

PROJECT DESCRIPTION

CHAPTER III
PROJECT DESCRIPTION

A. RECYCLED WATER MASTER PLAN

PROJECT OVERVIEW

The Recycled Water Master Plan (RWMP) is a planning document to provide long-term guidance for the development and use of recycled water throughout the City and County of San Francisco. It includes the following: (1) identification of categories of recycled water uses and potential users; (2) projected recycled water demand, or volume requirements; (3) water quality considerations for recycled water development and use; (4) description of proposed facilities to be constructed; and (5) phased implementation program. Objectives of the RWMP are described in Section II.A., Objectives, (pp. 7 to 11).

As described in Chapter II, the City currently is using potable water for numerous non-potable uses that could be replaced with recycled water. The RWMP estimates that by the year 2012 there is a potential, city-wide demand for non-potable water that can be supplied by recycled water of up to 10.3 million gallons per day (mgd), on an average day, or approximately 11,500 acre-feet per year (ac-ft/yr) in an average year.

Implementation of the RWMP would require construction of a recycled water treatment plant, two storage reservoirs, about 28 miles of new pipelines, two pump stations, and service connection vaults, all at various locations in the City. The recycled water treatment plant would use treated wastewater from the Oceanside Water Pollution Control Plant (WPCP) and provide additional treatment so that the quality would meet regulatory requirements and user needs. The recycled water would be conveyed through transmission pipelines to two storage reservoirs, and through additional distribution pipelines to various recycled water users throughout the City.

The transmission and distribution pipelines would be constructed in conjunction with the Auxiliary Water Supply System (AWSS) operated by the San Francisco Fire Department (SFFD). The recycled water supply system would be built to the same specifications established for the AWSS; it would connect to the existing AWSS at select points. The recycled water supply system would serve a dual purpose in providing recycled water for fire protection as well

as for identified site-specific recycled water users. The system would provide hydrants and a backbone for future Fire Department AWSS expansion.

This section presents a description of the proposed recycled water uses and users, the projected recycled water demand, water quality considerations, the proposed facilities, the three-phased implementation program, typical construction scenarios, estimated cost of the plan, and regulatory approval requirements.

PROPOSED RECYCLED WATER USES AND IDENTIFIED USERS

Recycled water can be used for a variety of non-potable uses in San Francisco, including landscape irrigation (e.g., parks, golf courses, schools, and street landscaping), toilet flushing, fire-fighting, commercial and industrial cooling systems, and other industrial uses. In other parts of California, recycled water is also used extensively for groundwater recharge,[1] though groundwater recharge is not presently proposed as part of the RWMP. Appendix B Regulatory Framework (pp. B-1 to B-12), describes the permitted uses of recycled water and the water quality standards, treatment and use management regulations that direct recycled water use in California.

As described in Section II.B., Development of Master Plans (pp. 12 to 18), the City reviewed all non-potable water uses in the City to identify those which are suitable for recycled water and can be served cost effectively by the proposed recycled water system. In addition, the City has designed the recycled water distribution system to serve a dual purpose of expanding the City's fire protection system, the AWSS.

Table 3 lists the proposed major recycled water users to be served by the system as identified in the RWMP. These targeted users are shown on Figure 9 (p. 32), and are grouped into four service areas that relate to how the distribution system is designed. The four service areas that would be served recycled water are called the Richmond, Sunset, Southwest, and Southeast areas and are defined by the location and elevation of the users. Table 3 also shows the projected demand for each user, for each of the four service areas, and for the overall system. Assumptions used in calculating estimated recycled water demand are discussed in the following section, Recycled Water Demand (pp. 34 to 37).

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[1] Groundwater recharge with recycled water is the practice of either injecting recycled water into aquifers through wells or allowing recycled water to percolate into aquifers from spreading basins.

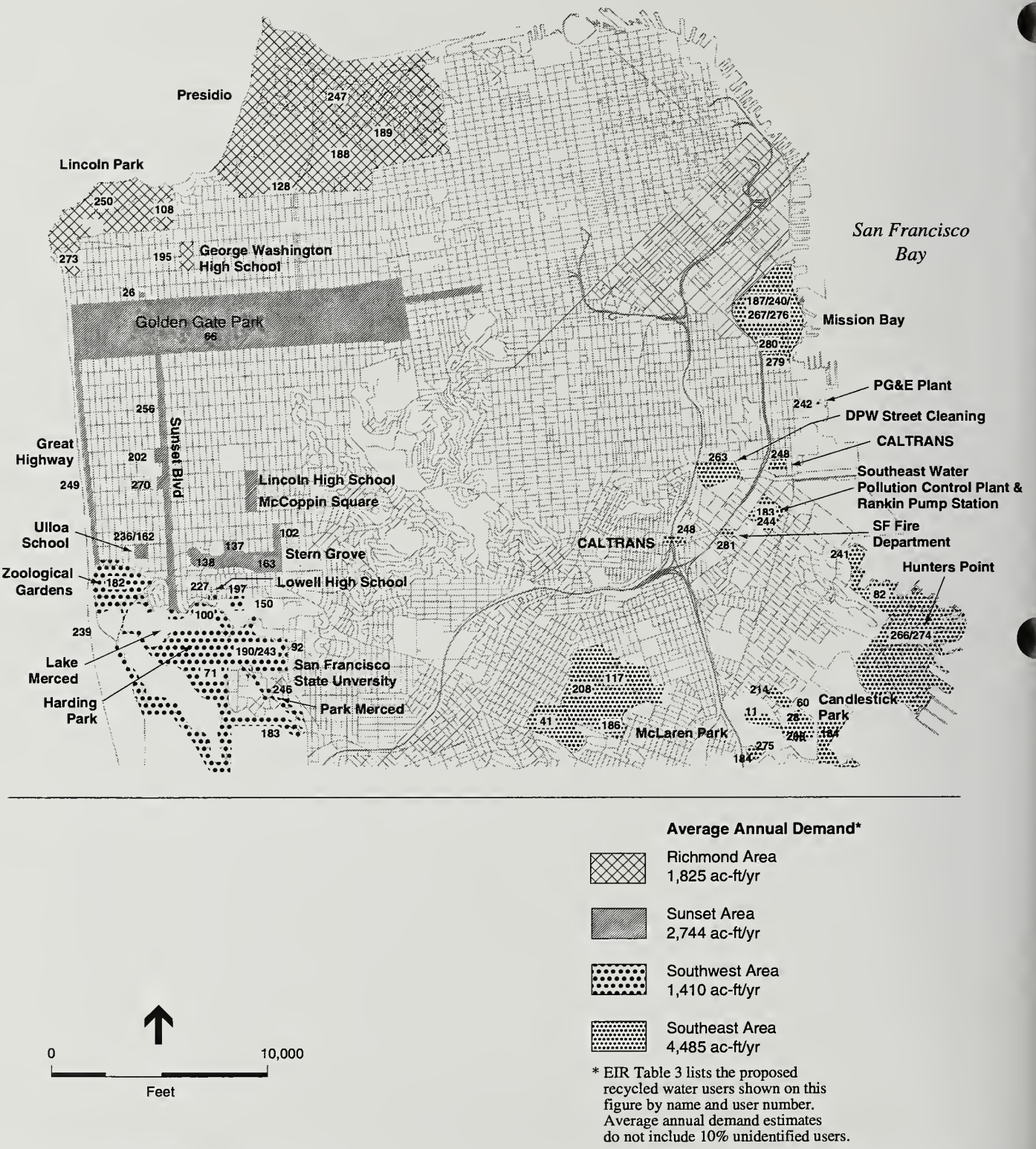
TABLE 3: PROPOSED RECYCLED WATER USERS BY SERVICE AREAS AND PROJECTED DEMANDS

Primary Users /a/	Phase	Annual Demand ac-ft/yr	Annual Demand mgd	Peak Month Demand mgd
Sunset Area				
Stern Grove (102, 137, 138, 163)	1	56	0.05	0.09
Ulloa HS, South Sunset PG (162, 236)	1	11	0.01	0.01
Great Highway (249)	1	291	0.26	0.44
Sunset Blvd. (180,202, 256, 270)	1	375	0.33	0.57
Golden Gate Park (66, 26)	1	1,972	1.76	3.00
A. Lincoln HS, McCoppin Square (115, 192)	1	17	0.02	0.03
S.F. Fire Dept AWSS (261).	1	22	0.02	0.02
Subtotal Zone Flow		2,744	2.45	4.16
Southwest Area				
Lowell HS & Lakeshore ES (150, 197, 227)	1	11	0.01	0.02
Lake Merced, Harding Pk. (71, 100)	1	694	0.62	1.05
Zoological Gardens (182)	1	526	0.47	0.80
San Francisco State University (92, 190, 243)	1	93	0.08	0.17
S.F. Fire Dept. AWSS (261)	1	22	0.02	0.02
Park Merced (246, 183)	1	56	0.05	0.08
Oceanside WPCP (239)	1	8	0.01	0.02
Subtotal Zone Flow		1,410	1.26	2.16
Richmond Area				
S.F. Fire Dept. AWSS (261)	1	22	0.02	0.02
George Washington HS (195)	1	11	0.01	0.02
Lincoln Park (108, 250, 273)	1	538	0.48	0.82
Presidio (128, 188, 189, 247)	1	1,254	1.12	1.91
Subtotal Zone Flow		1,825	1.63	2.77
Southeast Area				
Mission Bay (187, 240, 267, 276, 279, 280)	2/3	856	0.76	0.83
Candlestick Park (11, 60, 28, 184, 238, 214, 185, 275)	2/3	678	0.61	0.83
Hunters Point (82, 241, 266, 274)	2/3	1,742	1.56	1.68
DPW Street Cleaning (263)	2	11	0.01	0.02
Caltrans (248)	2/3	235	0.21	0.35
Southeast WPCP and Rankin PS (244, 283)	2	45	0.04	0.07
PG&E Potrero Hill Plant (242)	2	67	0.06	0.06
S.F. Fire Dept. AWSS (261)	2	56	0.05	0.05
McLaren Park (41, 186, 117, 208)	2	795	0.71	1.20
Subtotal Zone Flow		4,485	4.01	5.09
SUBTOTAL, ALL ZONES		**10,464**	**9.4**	**14.2**
Unidentified Uses 10% reserve /b/		1,054	0.9	1.4
GRAND TOTAL		**11,518**	**10.3**	**15.6**

AWSS: Auxiliary Water Supply System; ac-ft/yr: acre-feet per year; mgd: million gallons per day.

/a/ Numbers in parentheses indicate user numbers, as shown in Figure 9.
/b/ Limited supply of Oceanside Plant, assumes additional unidentified uses during peak month made up with alternative water supply

SOURCE: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996.



SOURCE: City and County of San Francisco, *Recycled Water Master Plan*, Draft, July 1996

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Figure 9
Proposed Recycled Water Users by Service Area

Landscape irrigation uses represent the largest potential demand in the City for recycled water. The major irrigation users identified are Golden Gate Park, the Presidio, McLaren Park, Lincoln Park, the San Francisco Zoo, and the area around Lake Merced. The projected demands for office cooling systems and toilet flushing are associated with the major planned developments and redevelopment projects such as Mission Bay and Hunters Point commercial redevelopment. The PG&E power plants at Hunters Point and Potrero Hill represent the chief potential industrial uses of recycled water. A brief description of the major proposed recycled water uses within each of the four service areas follows.

Richmond Area

The Richmond Area includes the northwest corner of the City, north of Golden Gate Park. There are nine targeted recycled water users within this zone. The largest potential users include the Presidio, Washington High School and Lincoln Park.

Sunset Area

The Sunset Area includes the area between Golden Gate Park and Sloat Boulevard. There are 13 targeted recycled water users within this service area, including Golden Gate Park, Ulloa School, Stern Grove, and landscaping along the Great Highway and Sunset Boulevard. Golden Gate Park would be the single largest user in the City's recycled water program.

Southwest Area

The Southwest Area includes the Lake Merced area south of Sloat Boulevard and west of Junipero Serra. This area has 14 designated potential recycled water users including Lowell High School, Lake Merced/Harding Park, the Zoological Gardens, and San Francisco State University.

Southeast Area

The Southeast Area includes the area south and east of the Highway 101-280 interchange corridor encompassing the Mission, Bayview and Excelsior Districts. There are 26 designated potential recycled water users in this area including the proposed Mission Bay development, Candlestick Park, Hunters Point, PG&E power plants, and McLaren Park. In addition, Caltrans would use the water for highway landscape irrigation, and the City would use it for street cleaning.

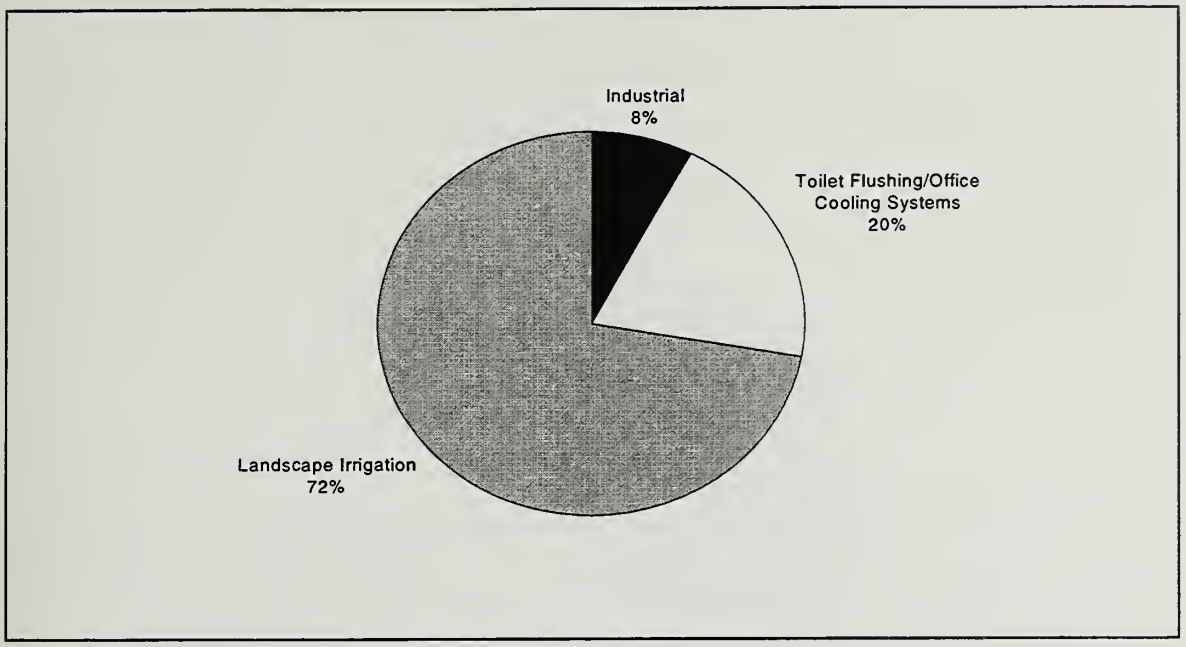
RECYCLED WATER DEMAND

The projected demand estimates for each of the designated recycled water users within the four service areas are shown in Table 3 (p. 31), and Figure 10 is a graph of the recycled water demand data by use category. As shown on Figure 10, landscape irrigation uses represent about 72 percent of the City's total projected demand, followed by toilet flushing/office cooling systems at 20 percent, and industrial uses at 8 percent (includes AWSS practice fire fighting uses and street cleaning washdown).

The recycled water demand estimate was developed in the RWMP based on the results of a user survey and supplemented by calculated demands for non-potable water users. It was assumed that since groundwater on the westside of the City is of potable quality (see Section V.B., Groundwater Quality, pp. 401 to 407), all identified non-potable users in this part of the City would be served recycled water, and groundwater would be reserved for potable uses. The estimated demands are presented in terms of annual average demand, and peak month demand.

The recycled water demands were calculated using available site-specific user information, historical water records, or generalized use assumptions for the various categories of non-potable uses. Irrigation and non-irrigation demands were calculated independently. Irrigation users mainly include parks, golf courses, playgrounds and schools. Non-irrigation users include toilet flushing, cooling systems, and other industrial or non-potable uses.

For irrigation users, water requirements fluctuate based on the weather, climate and time of year. The recycled water demand was developed to meet the average-day, peak-month irrigation water demand so that the recycled water treatment plant would be designed to provide a non-interruptible source of water during the irrigation season. Average annual demand was also calculated to determine the annual potable water savings for uses that would be replaced with recycled water. Estimated irrigation demand for recycled water was calculated in one of two ways: (1) from current and historical records of metered water consumption at major irrigation sites, and (2) from historical evapotranspiration rates for the Central Coast of California applied to the number of irrigated acres. For those irrigation sites with water consumption records, the peak month demand was calculated by multiplying the average annual water demand by a peaking factor of 1.7. For the remaining irrigation users, the estimated demand for recycled water was assumed to correspond to the daily evapotranspiration rate during the hottest months of the year (July and August) and was calculated based on an application rate of 0.14 inches per



NOTE: Percentages based on total potential average annual demand (10.3 mgd).

San Francisco Recycled Water Master Plan / 910641

SOURCE: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996.

Figure 10
Breakdown of Recycled Water Demand by Type of Use

day per irrigated acre during the irrigation season. The average annual irrigation rate is roughly two and one half feet of water per year per irrigated acre.

For non-irrigation users, estimated recycled water demand was based on either historical meter records for site-specific users (generally industrial users) or water use factors for various types of uses based on building size. Recycled water demand for toilet flushing (dual plumbing) was based on a generalized use rate of about 20 gallons per day per 1,000 square feet of building space. Office cooling systems were estimated to require about 6,000 gallons per day per 100,000 square feet of building space. The recycled water demand estimate for toilet flushing and cooling system water was developed only for those buildings located within the Reclaimed Water Use Areas defined in the Reclaimed Water Use Ordinance (see Figure 2, p. 8), because they would be adjacent to the recycled water distribution system and are the only buildings required to add dual plumbing for toilet flushing and cooling systems.

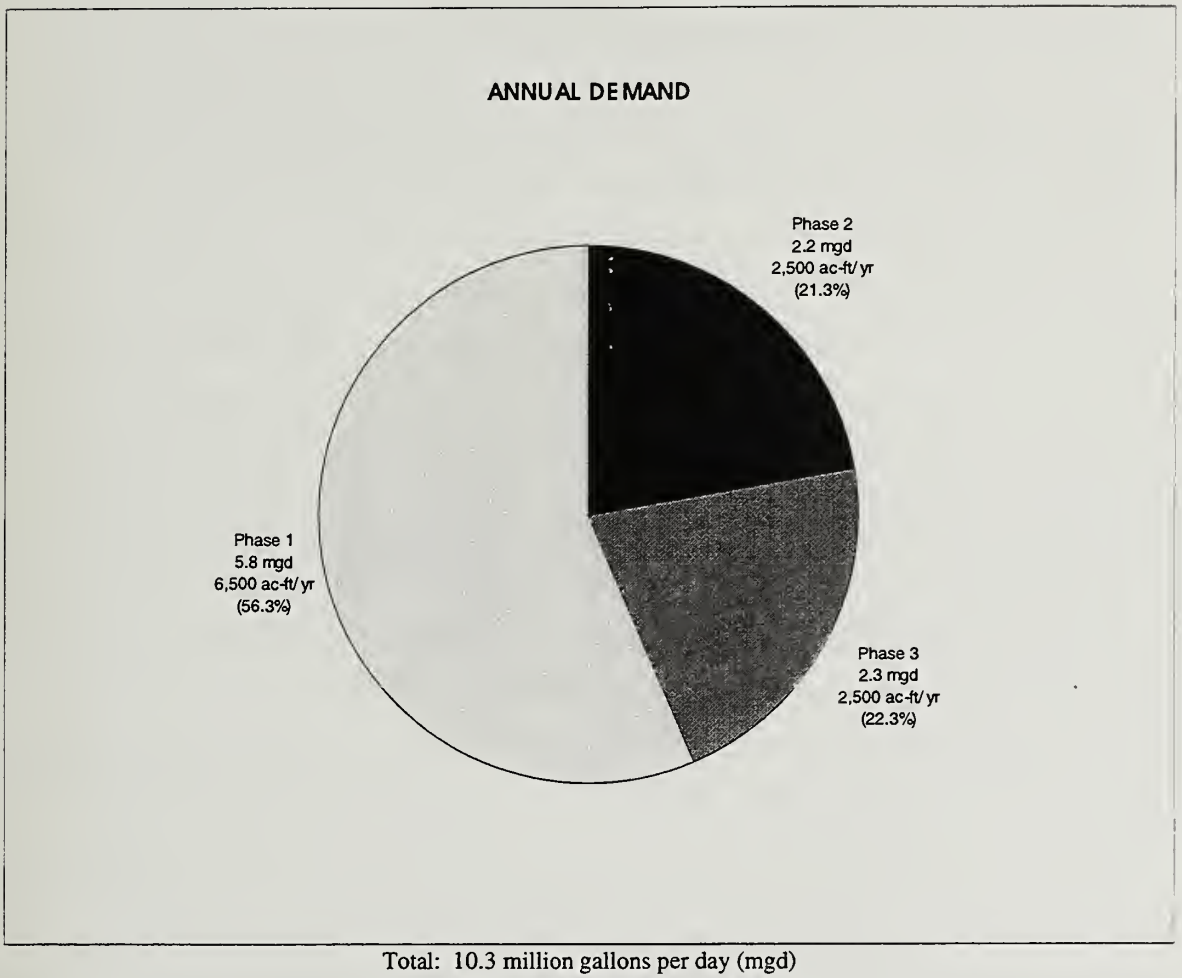
For areas such as Mission Bay or Hunters Point, a combination of irrigation and non-irrigation water demands were estimated to determine total recycled water demand. At the planned

Mission Bay development, irrigation water was estimated for 6.8 acres of landscaped open space and an additional 75 acres for the adjacent Mission Bay Golf Center. Dual plumbing for office use at Mission Bay was estimated based on 17 gallons per day per 1,000 square feet. Other specific water use factors were developed for office buildings, the hotel and schools at Mission Bay. At Hunters Point, it was assumed that land use patterns similar to the planned Mission Bay development would eventually occur in the future following closure of the Naval shipyard. The recycled water demand at Hunters Point was estimated proportionally to Mission Bay's estimated demand with respect to site area.

All the targeted recycled water users are proposed to be connected to the system by the year 2012. By the year 2012, the total average annual recycled water demand is estimated to be 10.3 mgd (equal to 11,500 ac-ft/yr). This estimate includes a 10 percent reserve to allow for the addition of other users to the recycled water system beyond those currently identified.

The recycled water system would be installed in three phases. Table 3 (p. 31), indicates the phase in which each proposed user would be connected to the system. The first phase is targeted for completion by the year 2001. The proposed Phase 1 facilities would provide service to almost all of the westside users within the Richmond, Sunset, and Southwest service areas. The estimated demand for Phase 1 is 5.8 mgd average annual flow (equal to 6,500 ac-ft/yr). With Phase 2 (target completion year 2006), service would be initiated to the eastside of the City, with connections to most of the eastside users in the Southeast service area. Since the primary users on the eastside, Mission Bay and Hunters Point, are not expected to be fully developed prior to Phase 3, it is estimated that approximately half the projected total recycled water demand for the eastside would occur during Phase 2. Phase 3 (target completion year 2012) would complete the transmission pipeline to the Southeast Zone and complete connections to remaining users. Figure 11 summarizes the projected total average recycled water demand by phase. Refer to the section on Project Implementation, pp. 60 to 67 below, for more information on project phasing.

By the year 2012, the peak month average day demand is estimated to be 15.6 mgd. The majority of recycled water would be used for landscape irrigation for which water demand varies seasonally, with the peak demand occurring during the dry season. The peak month demand represents the average day irrigation use that occurs during the peak use month of August. This demand estimate was used in the RWMP to determine the size of the recycled water treatment, storage and pumping facilities.



Total: 10.3 million gallons per day (mgd)
Total: 11,500 acre-feet per year (ac-ft/yr)

San Francisco Recycled Water Master Plan / 910641

SOURCE: Environmental Science Associates

Figure 11
Projected Recycled Water Demand by Phase

The secondary effluent supply from the Oceanside Plant is currently limited to about 15 mgd during the dry season, although future flows may increase if higher density development occurs on the westside of the City. The Oceanside Plant can provide sufficient secondary treated effluent to meet the projected 14.2 mgd peak demand for all identified recycled water users as shown on Table 3 (p. 31). However, if additional recycled water users are added to the system, any peak recycled water demand that exceeds 15 mgd available supply would need to be met by other sources of water, such as groundwater or the City's potable supply.

USER WATER QUALITY CONSIDERATIONS

The proposed recycled water system is designed to meet all existing regulatory standards and requirements as well as additional user-specific water quality considerations.

Regulatory Requirements

The key water quality and public health regulations that apply to recycled water are summarized in Appendix B, Regulatory Framework (pp. B-1 to B-12). To summarize these regulations, the State Department of Health Services (DOHS) has developed comprehensive water recycling regulations that establish treatment processes, water quality criteria, and treatment reliability requirements in order to ensure that the use of recycled water for specific purposes does not impose undue health risks. These regulations are listed in Title 22, Division 4 of the *California Code of Regulations*, and are incorporated into the waste discharge permits issued to water recycling producers and users by the Regional Water Quality Control Board (RWQCB). The Title 22 regulations specify treatment and disinfection performance criteria for various uses of recycled water. The most stringent requirements are provided for landscape irrigation with high public contact and for recreational impoundments with non-restricted access (i.e., where swimming is allowed). The City's proposed recycled water treatment system is designed to comply with the most stringent water quality and public health standards. The proposed treatment process is described below under Proposed Facilities (pp. 39 to 60).

User-Based Considerations

In addition to full compliance with public health water quality standards, the specific water quality needs for the various types of uses and users were also considered in designing the recycled water treatment process. The user-based considerations were identified along with demand information during the user survey as the RWMP was developed. In addition, acceptability guidelines for irrigation with recycled water developed by UC Davis were incorporated into the user-based requirements for irrigation. Effluent from the Oceanside Water Pollution Control Plant, rather than from the Southeast Water Pollution Control Plant, was selected for tertiary treatment due to its higher quality (i.e., lower salts and trace metals) and better suitability for user quality needs.

The major limiting factor for use of recycled water for irrigation, office cooling systems, or industrial process applications is the salt content of the water. The salinity of water is typically measured by the concentration of total dissolved solids (TDS), which is comprised of all

dissolved constituents (e.g., sodium, potassium, magnesium, calcium, chloride, carbonate, bicarbonate, sulfate, and other trace elements). High salinity levels in irrigation water limit the ability of plants to uptake water (since the salts can accumulate in the root zone and can increase the osmotic pressure of the soil solution), and excess amounts of certain ions (i.e., chlorides and boron) can be toxic to some plants. In addition, water with a high concentration of total dissolved solids, particularly chloride, can be corrosive to buried, uncoated metal pipes, depending on the soil and groundwater conditions.

For office cooling systems and industrial process applications, the water quality requirements would be site specific; but, generally the higher the salinity the less desirable the water. In cooling systems, for example, higher hardness and TDS would require the addition of more chemicals for scaling control and more frequent blowdown of cooling water,[2] thus increasing water demand. These water quality issues were considered in the RWMP in developing the treatment options for serving potential users.

PROPOSED FACILITIES

System Overview

The proposed RWMP system would consist of a new treatment plant, two storage reservoirs, two pump stations and distribution pipelines with service connection vaults. The City evaluated a number of system design alternatives as well as several specific site alternatives for each proposed facility. The preferred system and proposed facility locations are presented in the *Draft Recycled Water Master Plan* report issued in July 1996.[3] The alternatives considered are reviewed in Chapter IX (pp. 502 to 524) of this report

The proposed recycled water system and location of proposed facilities are shown in Figure 12. The system includes the following components: (1) a new tertiary treatment plant located at the Fleishhacker Pool site adjacent to the San Francisco Zoo and the Oceanside WPCP; (2) storage reservoirs located at Lincoln High School and McLaren Park; (3) pump stations located at the

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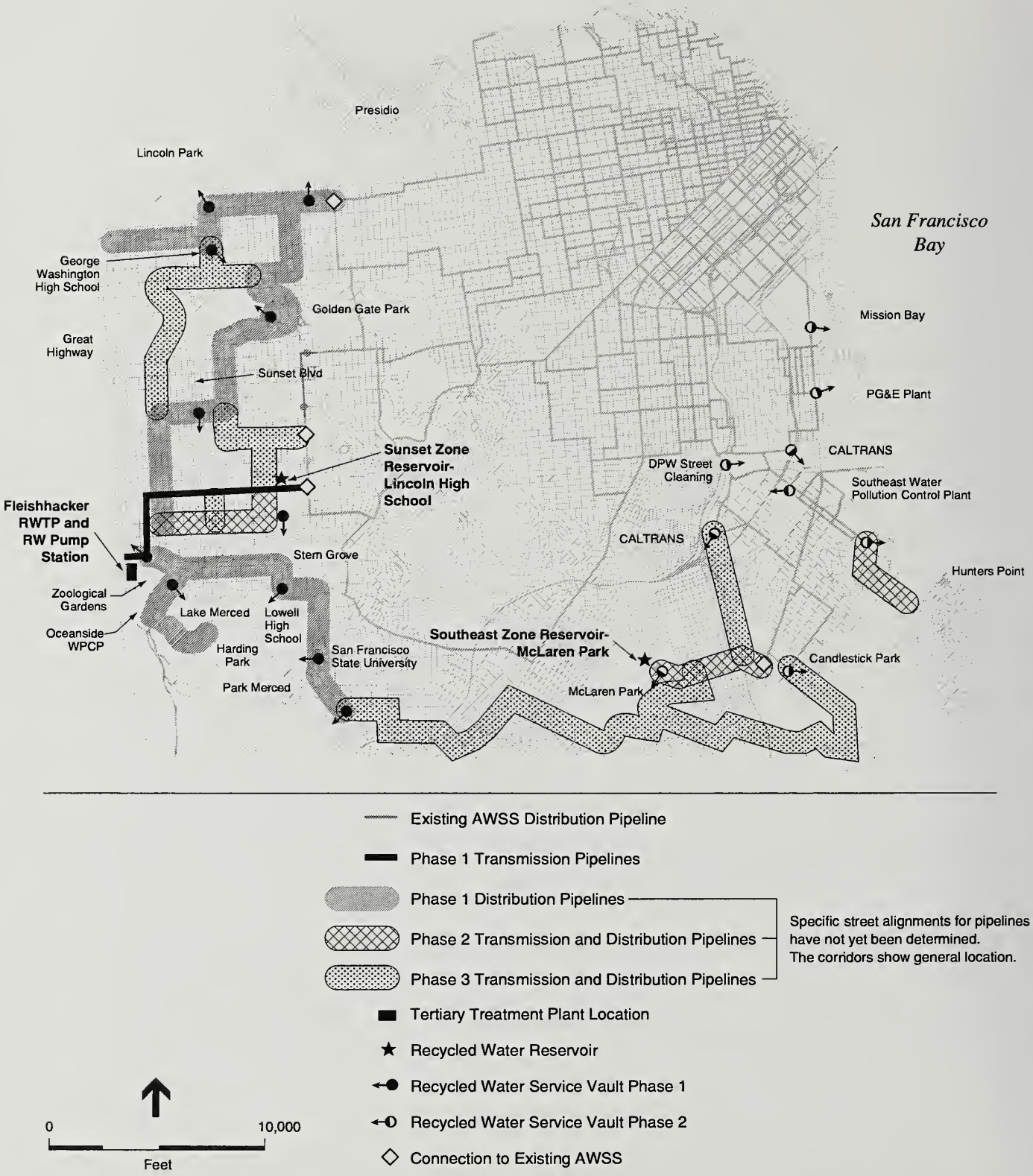
2 In some industrial cooling systems, water is used as a medium for heat exchange, and it is recirculated through the system to remove the excess heat accumulated during the industrial processes. Discharge of the cooling water is referred to as "blowdown," and inflow to the cooling system is referred to as "make-up" water. Typically, there is a five- to eight-fold concentration increase between make-up and blowdown water in cooling towers. Higher concentration of salts in the make-up water would require more frequent blowdown of cooling water to prevent problems with scale formation and corrosion. Some cooling systems are "once-through" systems, which have less stringent water quality requirements for make-up water.

3 City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996.



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SOURCE: City and County of San Francisco, *Recycled Water Master Plan*, Draft, July 1996, modified by Environmental Science Associates

Figure 12
Proposed Recycled Water System Facilities

treatment plant and Lincoln High School; and (4) transmission and distribution pipelines to connect the treatment plant to the reservoirs and to connect the reservoirs and the user sites either directly, or indirectly through the existing AWSS. Each of the components in the recycled water system is described below. As Figure 12 shows, new recycled water distribution pipelines would be connected to the existing fire protection AWSS network and would expand this system into previously unserved areas throughout the western half and southern portions of the City.

Recycled Water Treatment Plant

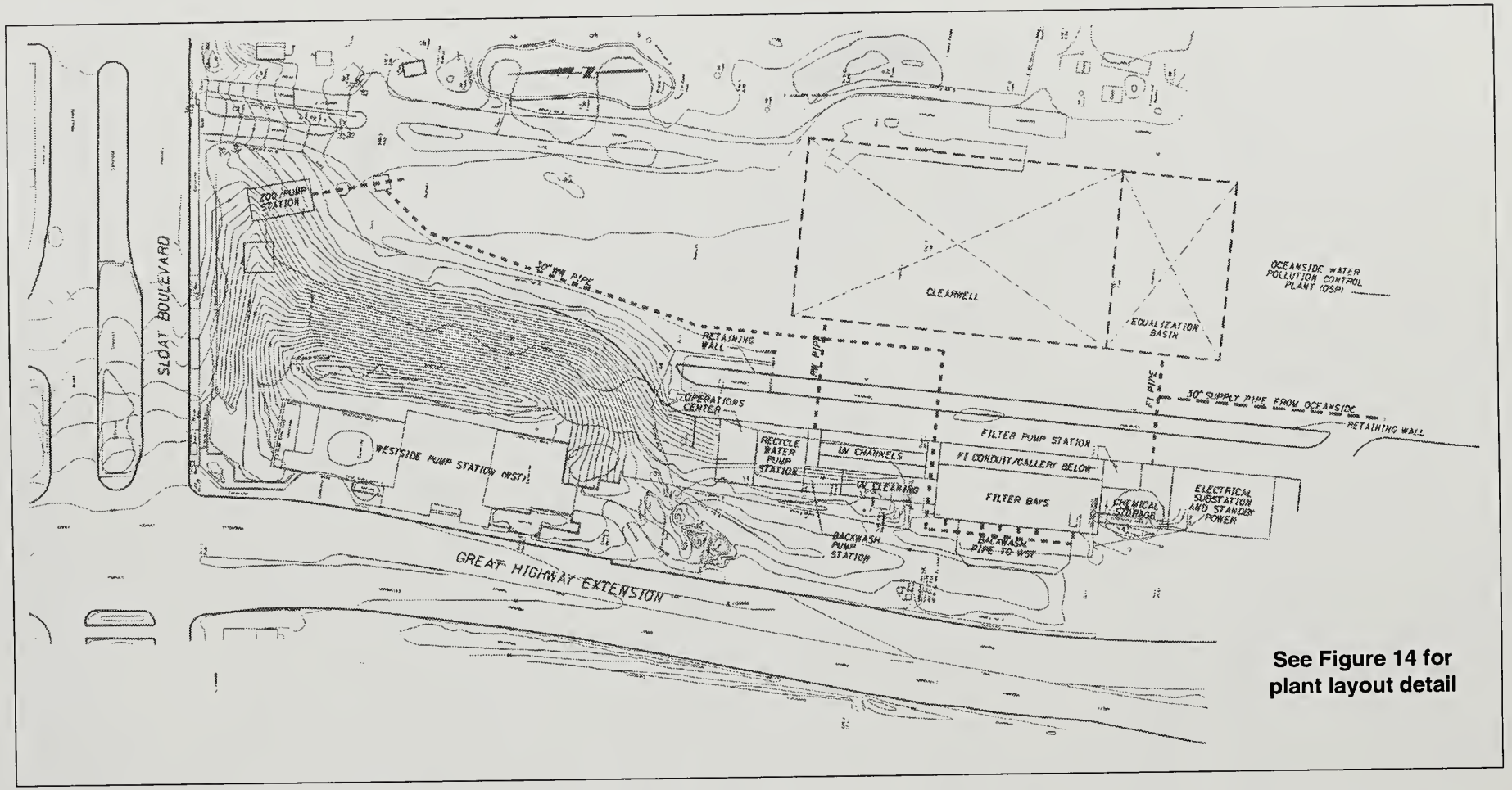
Location and Site Layout

The proposed Recycled Water Treatment Plant (RWTP) would be located at the Fleishhacker Pool site adjacent to the San Francisco Zoo (see Figure 12). The proposed layout and elevation of the RWTP facilities are shown in Figure 13. Figure 14 shows more detail for the RWTP. The plant would include the following major components:

- an equalization storage facility to balance the flow of secondary effluent from the Oceanside WPCP before it is sent through the RWTP;
- a filtration system;
- a disinfection system;
- a clearwell storage reservoir to hold tertiary treated, recycled water until it is pumped to the reservoirs; and
- a pump station to pump recycled water to the reservoirs and distribution network with standby power

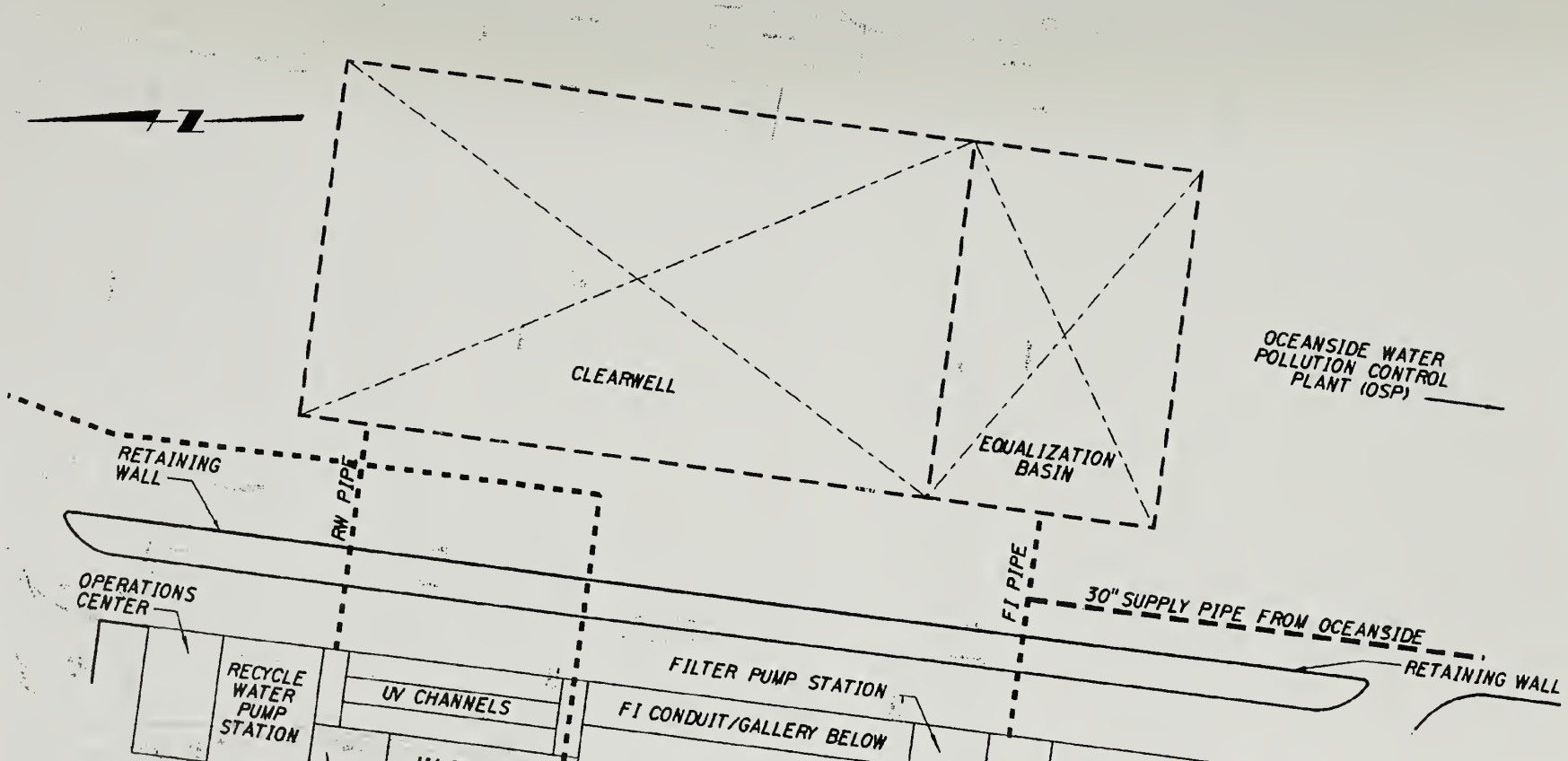
The Fleishhacker site is part of the San Francisco Zoological Gardens. The property is owned by the City and County of San Francisco and is managed through a partnership between the San Francisco Recreation and Park Department and the non-profit San Francisco Zoological Society.[4] The City is coordinating with the Zoo staff to develop the RWTP design and construction plans to be compatible with the Zoo's existing and proposed uses of the Fleishhacker Pool site. The Bath House was built in 1925 as part of the pool complex. This history and use of the pool complex is discussed in Section IV.K., Cultural Resources Setting (pp. 243 to 250).

[4] San Francisco Zoological Society, *San Francisco Zoological Gardens Master Plan Report Manual*, June 1994.



SOURCE: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996

Figure 13
Recycled Water Treatment Plant Layout



SOURCE: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996

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Figure 14
RWTP-Layout Detail

As indicated on Figure 13 (p. 42), the RWTP facilities would be constructed both above and below ground. With a maximum height of 40 feet above ground and an area of about 25,000 square feet, the above-ground structure would house the operations center, the filtration and disinfection systems, the chemical storage, and the electrical substation and standby power. The below ground structures would include the secondary effluent pump station, equalization basin and clearwell storage, with a maximum depth of 15 feet below the ground surface.

The old Bath House structure and remnants of the pool would be demolished, and the treatment facilities would be constructed in their place. The above-ground portions of the treatment plant would generally be designed to fit within the footprint of the existing abandoned Bath House. The Bath House structure provides effective wind protection for the Zoo. Thus, the Zoo planning personnel prefer retaining height at this location with either a screened structure and/or a landscaped berm. Wind protection would be incorporated into the design phase of the RWTP. The City has received prior approval to install a landscaped berm along the Great Highway from the Westside Pump Station south to the OWPCP. This berm would be completed during the RWTP construction.

Architectural treatment of the RWTP building would be determined during final design in conjunction with the Recreation and Park Department and in consideration of the proposed Zoo Master Plan described below. An access road about 25 feet wide and 500 feet long for plant maintenance activities would be constructed along the western face of the building.

The Zoo Master Plan proposes to relocate the Zoo entrance from Sloat Boulevard to the Fleishhacker pool site area. New vehicle access would be provided from the Great Highway and Sloat Boulevard. The area would be redeveloped with visitor parking and entrance facilities. (These proposed Zoo changes are discussed in the land use setting and impact analysis sections [IV.A and VA-1].) The proposed new access point to the Great Highway would be developed initially during RWTP construction and would be used for construction traffic.

As shown on Figure 13 (p. 42), siting the equalization and storage treatment facilities below ground at the site of the former pool area would accommodate the Zoo's plan to convert this area to the main entrance and public visitor parking area. The Zoo's existing and proposed use of the Fleishhacker Pool site are described further in Section IV.A., Land Use Setting (pp. 112 to 147).

Treatment Process

The RWTP would receive treated wastewater (called secondary effluent) from the neighboring Oceanside WPCP. The secondary effluent would receive additional treatment at the RWTP to achieve a tertiary level of treatment.

The treatment requirements for the tertiary treatment plant are stipulated in Title 22, Division 4 of the *California Code of Regulations* (Title 22), and the proposed treatment facilities are subject to approval by the DOHS. The DOHS has developed comprehensive water recycling regulations that establish treatment processes, water quality criteria, and treatment reliability requirements, as listed in Title 22. Title 22 and other regulations that apply to recycled water are summarized in Appendix B, Regulatory Framework (pp. B-1 to B-12).

Treatment requirements are based on the quality of the influent (i.e., for this project, the influent would be the secondary effluent from the Oceanside WPCP) and the recycled water use. The Title 22 regulations and DOHS guidelines specify criteria for design, operations and treated water quality for various recycled water uses. The proposed treatment processes in the RWMP would provide the most stringent level of treatment stated in Title 22 (which is referred to as "disinfected tertiary") to allow for unrestricted uses of recycled water, such as landscape irrigation in areas with high public contact, toilet flushing, and cooling tower makeup water DOHS is in the process of revising Title 22 to provide additional flexibility in allowable treatment processes, to expand the permitted uses of recycled water, and to provide specific requirements for those additional uses. The latest draft of the proposed revised Title 22 regulations was released in May 1995. The draft revision shifts the emphasis away from design and operation-based regulatory criteria towards performance-based criteria.

The existing Title 22 wastewater reclamation regulations (1978) require clarification (coagulation, flocculation and sedimentation), filtration and disinfection. DOHS issued a direct filtration policy that allows clarification to be eliminated from the treatment process if certain additional criteria are met regarding the quality of secondary effluent and the design of the filtration and disinfection units.

The City's Bureau of Engineering has conducted several pilot tests in conjunction with the Bureau of Water Pollution Control to evaluate some of the alternative filtration and disinfection processes likely to be adopted by DOHS into the proposed revisions to Title 22. The City found that a treatment plant providing direct filtration followed by ultraviolet (UV) disinfection would

meet the water quality and public health standards (see Section V.A.3, Public Health Impacts (pp. 273 to 275). The proposed RWTP would be designed with this direct filtration/UV disinfection process.

Plant Design and Operation

The RWTP would be designed to accommodate 15.6 mgd peak month, average daily flow and 21.1 mgd peak diurnal flow. The RWTP would receive secondary effluent from the Oceanside Plant. Secondary effluent would be pumped from the Oceanside Plant to an equalization basin at the RWTP. Equalization would be necessary between the Oceanside Plant and the RWTP to allow independent operation of the recycled water treatment facilities. An equalization volume of 1.38 million gallons is proposed to allow maximum operational flexibility. Secondary effluent would be stored in the equalization basin when the secondary effluent flow is greater than the filter influent flow and would be withdrawn from the equalization basin when the secondary effluent flow is less than the filter influent flow. Without equalization, the recycled water treatment plant flow would vary with the Oceanside WPCP secondary effluent flow. Equalization would allow the recycled water treatment plant to operate at a steady flow to simplify operation and to maximize recycled water quality.

An intermediate pump station would then pump the secondary effluent to the filter channel as influent to the RWTP. Alum and/or polymer would be added to the influent flow downstream of the intermediate pump station. The flow would then undergo filtration through a granular media gravity filter system to reduce turbidity.

Filter effluent would flow through the UV contact basin where it would be exposed to UV light for pathogen inactivation to meet the Title 22 California disinfection standards. At this point, the flow would be of adequate quality to be tertiary effluent or recycled water suitable for unrestricted uses. Prior to being pumped to the distribution and storage system, the recycled water would be stabilized through the addition of caustic soda (sodium hydroxide) to increase the pH, and thereby reduce the corrosion potential of the recycled water on various plumbing and piping materials.

Tertiary effluent would then be pumped to the recycled water distribution system as needed, or flow to the clearwell for storage to allow independent operation of the recycled water pump station. Clearwell storage would allow the recycled water pump station flow to meet the diurnal recycled water demand. The pump station would have standby power. Standby power would

consist of a diesel generator and an underground storage tank diesel fuel.

The filters and the UV lights would be routinely cleaned to maintain performance. Washwater would be discharged back to the sewer system via the neighboring Westside Pump Station. Small amounts of sodium hypochlorite would be added periodically to the filter backwash to control algal growth.

Reservoirs

Two storage reservoirs would be constructed as part of the RWMP. A 15-million-gallon below grade reservoir below grade would be located at Lincoln High School. A 10 to 15-million-gallon below grade reservoir would be located at McLaren Park. The reservoirs would be buried concrete structures, about 25 to 30 feet deep. Small above-ground improvements would consist only of access to buried altitude vaults at the Lincoln site. A pump station and standby emergency power generation would also be constructed at the Lincoln High School site. Standby power would consist of a diesel generator and an underground storage tank diesel fuel. Following construction of the reservoirs, the ground surface would be restored to its existing land use.

Each of the reservoirs would have an altitude valve vault, a buried concrete structure that contains the reservoir inlet and outlet piping, valves, flow meters, and sodium hypochlorite metering facilities. The primary functions of the altitude valve vault would be to prevent the reservoir from overfilling and to meter the flow entering and leaving the reservoir. A potable water supply pipe, with backflow prevention and air gap separation, would be located in the altitude valve vault so that potable water would be available to fill the reservoir if recycled water is not available. A hypochlorite storage and feed system would be provided to control algae and assist in reservoir cleanings.

The reservoirs would provide water for both recycled water uses and fire protection. The reservoirs would serve the following functions: (1) provide for efficient pump operation and control; (2) provide for peak demand periods; (3) provide for additional reliability; and (4) provide an emergency source of water. The reservoirs and associated pumping facilities would deliver recycled water within an acceptable range of pressures for both purposes: generally 60 pounds per square inch [psi] for most users, but 100 psi or higher for fire-fighting purposes.

The capacity of the proposed storage reservoirs were determined based on operational storage, backup storage and emergency storage. Operational storage is the normal daily volume used for recycled water uses. Typically, the reservoir would be full during the daytime when there is limited recycled water demand and would be drawn down during the night when recycled water use, particularly irrigation demand, is high. Backup storage would be available to provide recycled water when there is a short-term disruption in recycled water availability, either from the treatment plant, pump station or pipeline. Emergency storage would primarily be used for fire fighting.

While storage would be required for the recycled water system, the volume of storage and location of the reservoirs has been largely determined by the City's fire protection needs. As a part of the master planning effort, the City investigated the emergency water storage requirements for the western and southwestern areas of the City under various fire-fighting scenarios.[5] Based on this study the Fire Department identified the following reservoir siting and design criteria:

- multiple sites throughout the community, rather than a single centrally located reservoir, with each reservoir supplying a specific pressure zone determined by elevation
- high elevation sites that allow for delivery of water with higher water pressures (100 psi or greater) under gravity flow (with no power required for operation)
- adequate capacity to provide for normal to worst-case emergency scenarios (i.e., 15-20 mg)

For a worst case emergency scenario of a fire following an earthquake, the study recommended that storage reservoirs in three major sectors of the City provide a capacity of 20 million gallons to provide a high level of fire protection. The study indicated that for most normal fire-fighting scenarios, 15 million gallons of total storage would provide adequate emergency supply. However, for the fire following an earthquake scenario, the study recommended that each of the three zones have a storage capacity of 20 million gallons to provide a high level of fire protection. The study recommended that a reservoir of up to 20 million gallons be sited within each of three of the proposed recycled water distribution zones: Sunset Zone, Richmond Zone, and Southeast Zone. The fourth Southwest Zone could be adequately served by either the Sunset Zone or the Southeast Zone Reservoir for both recycled water and fire-fighting demand.

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[5] EQE, International, Portable Water Supply Systems, July 1994. *Reclaimed Water/Fire Protection Dual Use System, Analysis of Hydraulic and Reliability Aspects.*

Together Department of Public Works and the Fire Department investigated reservoir sites that could serve a dual purpose for recycled water distribution and fire-fighting. Several potential reservoir sites throughout the four distribution zones comprising the proposed recycled water use service area were identified and evaluated.[6] The alternative reservoir sites considered are noted in Section IX.C., Project Alternatives, and Appendix D.

Due to siting, potential environmental, and economic constraints, the reservoir locations and capacities recommended by the Fire Department could not be fully satisfied as part of the recycled water system. However, the Department of Public Works and Fire Department reached an agreement regarding the recommended capacities of the storage reservoirs, as presented in Table 4. Table 5 shows the expected water delivery pressures from the proposed reservoirs.

The two proposed reservoirs meet the dual purpose needs of the recycled water distribution and fire-fighting and achieve most of the desired siting and sizing criteria. Neither site could provide for a full 20 million gallon reservoir. The Lincoln High School reservoir site would serve the Sunset Zone. As shown on Table 4, this reservoir would have a capacity of 15 to 20 million gallons. The McLaren Park reservoir would serve the Southeast Zone; it would have a capacity of 10 to 15 million gallons. Fire-fighting demand for the Southwest Zone could be met from either of these two reservoirs.

The recycled water system storage needs for users within the Richmond Zone can be met from the Sunset Zone reservoir at Lincoln High School. The Sunset Reservoir would also provide improved fire-fighting capability for the Richmond Zone. It would provide an additional supply of water for fire protection/emergency use; however, it could not provide water at the higher pressure desired by the SFFD in some higher areas of the Richmond Zone. The Fire Department is likely to pursue additional system storage in the future.

Lincoln High School Reservoir

The proposed reservoir located at Lincoln High School would serve the Sunset and Richmond Zones. The school is located between 22nd and 24th avenues and between Quintara and Santiago streets (see Figure 12, p. 40). The site is owned and managed by the San Francisco School District. The proposed 15-million-gallon reservoir would be a buried concrete structure

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6 Environmental Science Associates, *Technical Memorandum - Richmond Zone Reservoir Alternatives: Golden Gate Heights Park and Buena Vista Park*, December 1995.

TABLE 4: RECYCLED WATER RESERVOIRS - STORAGE VOLUMES

Reservoir Zone	Location	Operational Volume (Mgal)	Backup/ Emergency Volume (Mgal)	Total Volume (Mgal)
Sunset	Lincoln High School	4.3	10.7-15.7	15-20
Southeast	McLaren Park	2.1	8.6-12.9	10-15

Mgal: million gallons

SOURCE: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996.

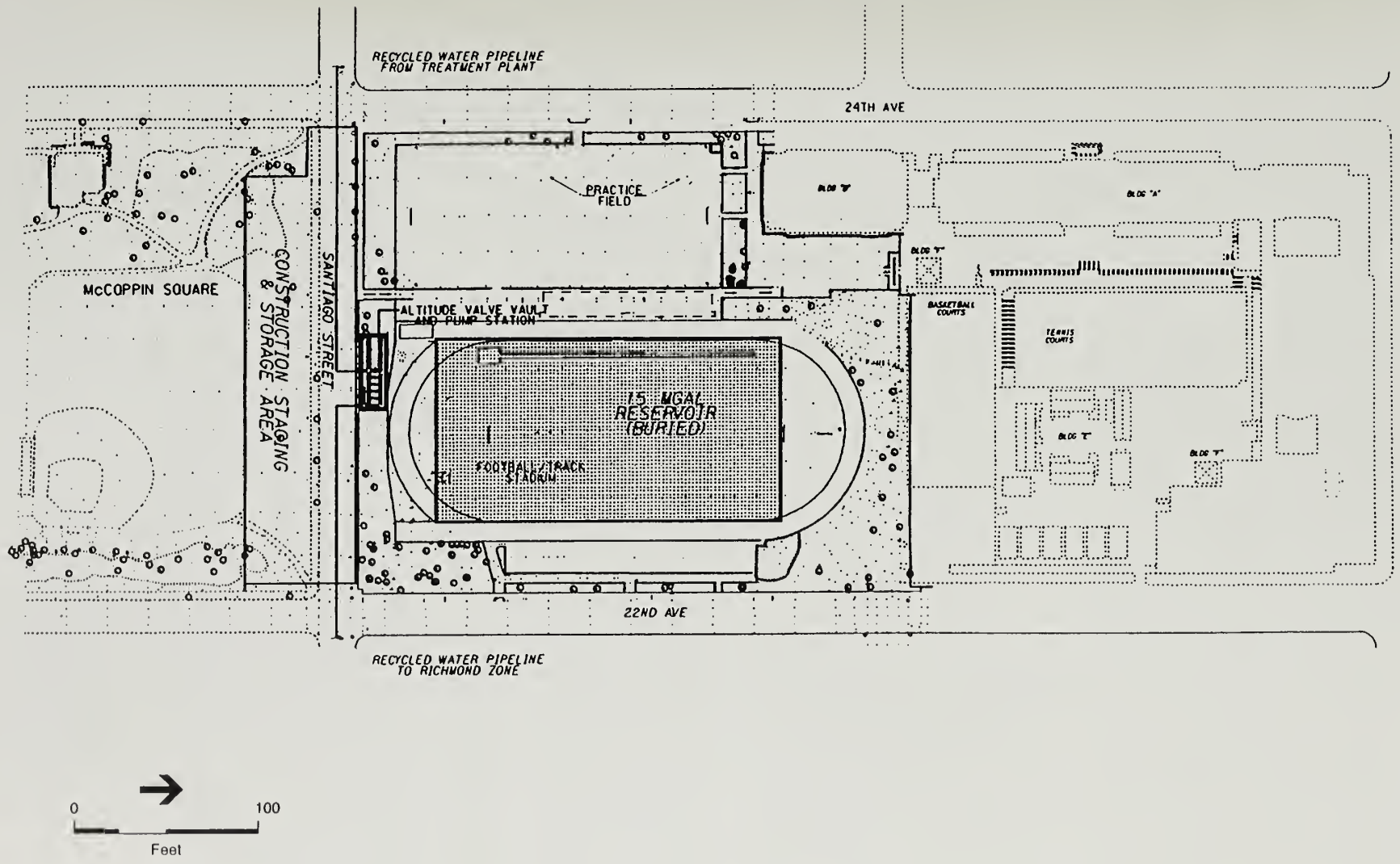
TABLE 5: RESERVOIR ELEVATIONS AND DELIVERY PRESSURES

Zone/Reservoir	Reservoir Elevation (ft)	Elevation Recycled Water Users (ft)	Maximum Elevation for 60 psi /a/	Static Pressure Range psi
Sunset/Lincoln High School	400	50 - 300	260	40 - 150
Southeast/McLaren Park	400	10 - 150	260	105 - 170

psi: pounds per square inch.

/a/ Static Pressure.

SOURCE: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996.



SOURCE: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996

Figure 15
Sunset Zone Reservoir -
Lincoln High Reservoir Site Layout

about 25 to 30 feet deep, constructed below the football stadium in the southeast corner of the school near 22nd Avenue and Santiago Street. Figure 15 shows the proposed layout. The underground reservoir would be approximately 420 feet long and 220 feet wide, occupying most of the field area. The estimated capacity of the reservoir at this site is 15 million gallons. During final facility design it may be possible to obtain slightly more capacity, (e.g., the addition of two to five million gallons) without changing the proposed area of affect evaluated here. Following construction of the reservoir, the ground surface would be restored and landscaped, with the football field and stadium rebuilt to allow continuation of existing land use.

An altitude vault also containing a pump station and standby engine generator would also be constructed at Lincoln High School. This facility would be located in the landscaped area just outside the football stadium to the south between the stadium's perimeter wall and Santiago Street. It would be partially buried with only an access doorway and structure aboveground. Under normal operating conditions, the pump station would pump at a maximum constant rate of 2.8 million gallons daily. The standby engine generator could operate the pump station at maximum capacity in the event of a power failure.

Temporary closure of Santiago Street between 22nd Avenue and 24th Avenue is proposed to allow for construction staging and access to the site. The City would also temporarily remove a section of the wall on the south end of the school along Santiago Street in order to access the site. In addition, the northern and western edges of the McCoppin Square Park, across Santiago Street from the school, would be used for construction staging and storage.

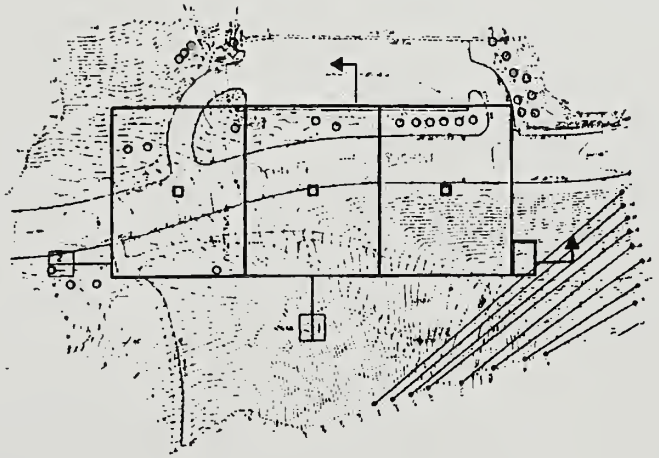
McLaren Park Reservoir

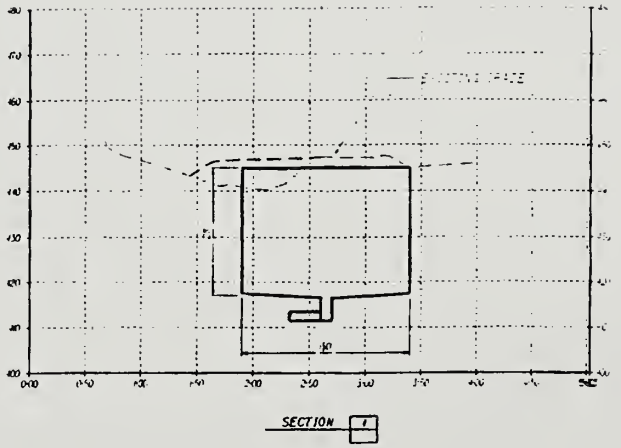
The proposed reservoir, located within McLaren Park just west of Highway 101 between the Excelsior and Sunnydale neighborhoods, would serve the Southeast Zone (see Figure 12, p. 40). McLaren Park is owned and managed by the San Francisco Recreation and Park Department. The 10- to 15-million-gallon reservoir would be constructed below ground at one of two sites within McLaren Park; Figure 16 shows the location of these two sites; Figures 17 and 18 (pp. 54 and 55) show the proposed reservoir layout at each of these two sites. The two sites are located in the John F. Shelley Drive loop road vicinity in the northern portion of the park.

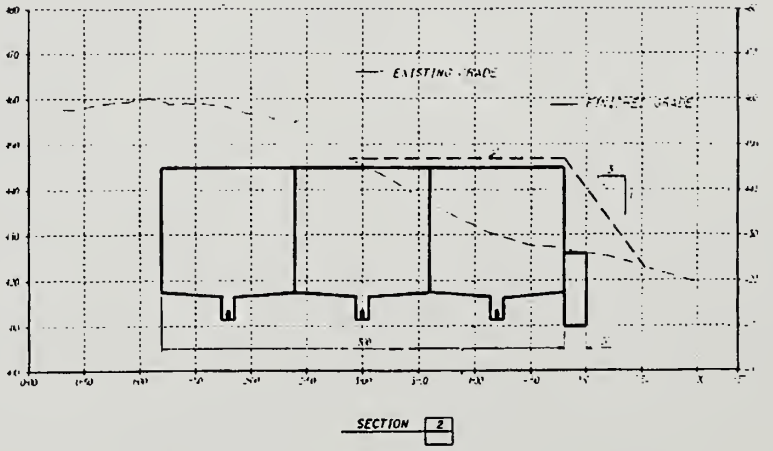
The first site alternative is located along John F. Shelley Drive in the northwest part of McLaren Park. The site would be adjacent to the existing Upper Reservoir, which is owned and operated

SOURCE: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996

SF RWMP / GWMP Program EIR ■ **Figure 16**
Southeast Zone Reservoir-
McLaren Park Reservoir Site Alternatives







SOURCE: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996

Figure 17
Southeast Zone Reservoir - McLaren Park
Site 1 Layout

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Figure 18

Southeast Zone Reservoir - McLaren Park
Site 2 Layout

SOURCE: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996

by the San Francisco Water Department and used for irrigation in the park. At this site, a 10-million gallon reservoir would be built beneath the parking lot and road. An altitude valve box would also be constructed below grade adjacent to the reservoir with an at-grade access hatch. This is the preferred reservoir site.

The second site alternative is located on the grass fields near the intersection of Shelley Drive and Mansell Street in the central part of McLaren Park. This site would accommodate one reservoir built as a divided structure with a total capacity of up to 15 million gallons. Depending on the site selected, the dimensions of the reservoir would be approximately 300 to 400 feet long, 150 to 250 feet wide and 30 to 35 feet deep. As indicated in the reservoir profile drawings shown in Figures 17 and 18, the reservoir would be constructed entirely below grade. An altitude valve box would also be constructed below grade adjacent to the reservoir on the east end with an at-grade access hatch. DPW is working closely with the Recreation and Park Department to design the facility. Regardless of the location within McLaren Park, the site would be restored following construction of the reservoir, either with a grass field or parking lot or possibly a visitors center, as proposed in the McLaren Park Master Plan.

The staging area for reservoir construction location at either of the two alternative sites would be located within the roadway. At Site 1, a segment of John F. Shelley Drive would be closed to through traffic adjacent to the upper reservoir parking area. The street would be used to store construction equipment and materials. It would be closed for the duration of the construction period, expected to be one year. Adjacent to Site 2, partial closure of John F. Shelley Drive would occur to provide a staging area. The street is wide enough in this location to allow one traffic lane to remain open during reservoir construction.

Transmission and Distribution Pipeline Network

Transmission pipelines would be constructed from the RWTP at the Fleishhacker Pool site to the two storage reservoirs. A pump station located at the RWTP plant would convey the recycled water to the reservoirs. The size of the transmission pipelines would vary from about 16 to 24 inches in diameter. Pipelines would generally be located within roadway rights-of-way, and the specific routing of the pipelines would be determined during the pre-design phase of the project.

Distribution pipelines to recycled water users would extend from the reservoirs and also branch directly from the transmission pipelines. Distribution pipes would range in size from 8 to

16 inches in diameter. The distribution system constitutes the recycled water supply system. The recycled water supply system would connect to the existing AWSS in a few locations.

The proposed alignment for the transmission pipeline from the RWTP site to Lincoln High School Reservoir would extend east along Sloat Boulevard for about two blocks to 45th Avenue, north on 45th Avenue for five blocks to Santiago Street, east on Santiago Street to the reservoir site. From the reservoir site, the transmission pipeline would continue east along Santiago Street for another 3 blocks and connect to the existing AWSS pipeline on 19th Avenue. These transmission pipelines would be constructed during the first phase of project implementation and are shown in Figure 12, p. 40. The specific transmission pipeline alignment from the RWTP to the McLaren Park reservoir site has not yet been identified (see Figure 12, p. 40 for general corridor location) and would be determined during subsequent phases of project implementation (see below, pp. 60 to 67 for description of project phasing).

There would be approximately 28 miles (about 145,400 linear feet) of new transmission/ distribution pipelines constructed for the recycled water system, ranging in size from 8 to 24 inches in diameter. Specific alignments of distribution pipelines and remaining transmission pipelines would be developed as needed following the identification of confirmed users and during the design of each of the three implementation phases of the RWMP. Specific distribution pipeline alignments would be determined based on recycled water needs, fire protection needs, and subsequent site-specific environmental review. A schematic of the proposed distribution system is shown in Figure 12 (p. 40).

Joint Use with AWSS System

Under the Apparent Best Alternative described in the RWMP, the recycled water supply system would connect to the existing AWSS and serve a dual purpose with fire protection throughout the recycled water service area.

Recycled water supply system connections to the existing AWSS would primarily be limited to the southeastern part of the City. The existing AWSS is concentrated in the downtown area and the Mission and South of Market areas. The proposed system would not connect to the downtown portion of the AWSS, as requested by the SFFD.

The system would be designed to meet AWSS standards. During the pre-design phase, the distribution system would be modeled and sized to provide for water supply and fire protection

service. Pipes would be made of strong ductile iron with flexible restrained joints, in accordance with AWSS standards. Recycled water users would be served through service vaults which would allow users to be isolated from the recycled water supply system during an emergency when the system is needed for fire fighting (e.g., service vaults would be shut down temporarily to stop the flow of recycled water to users and direct it for fire fighting).

The proposed distribution system configuration was developed in coordination with the SFFD to enhance fire protection. The system would be designed to ensure the fire-fighting reliability and at the same time to provide consistent delivery of recycled water to identified users during non-emergency periods. Fire fighting would be established as the highest priority use. All AWSS connections to the recycled water system and all service vaults would be under the direct control of the SFFD. As part of the pre-design process, all the specific operational requirements of the SFFD would be defined.

Each service vault would generally serve several local individual users. These service vaults would serve the following purposes: (1) to provide a single control location for the SFFD; (2) to isolate recycled water users from the AWSS and the recycled water supply system; and (3) to provide pressure reduction and metering. Proposed service vault control strategies are summarized in Table 6. Each service vault would be located on firm soil to minimize potential damage from liquefaction during an earthquake. To ensure that the SFFD has priority control of all connections to the recycled water supply system, the service vaults would have an automatic motorized isolation valve, modeled after the existing AWSS valve vaults, which can be controlled remotely by the SFFD Supervisory Control and Data Acquisition (SCADA) system or locally at a control panel. Control and status functions would be telemetered to the SFFD SCADA system. The SFFD would be able to close off the flow from the recycled water supply system during a fire to prevent loss of stored water or pressure reductions. The valve would have backup battery power supplies adequate to operate the isolation valve during power outages. It would also include other instrumentation and control features to isolate automatically the recycled water supply system from the AWSS during abnormal conditions, such as high pressure, earthquakes or line breaks.

The service pressure in the recycled water supply system would normally range from about 70 to 250 psi. Pressure above 100 psi is generally higher than the required pressure for most recycled water users. Therefore, each recycled water service vault would have a pressure regulation valve to reduce the pressure as needed for individual users. A flow meter would also be installed at

TABLE 6: DISTRIBUTION SYSTEM VALVE VAULT CONTROL STRATEGIES

Condition	Control Strategy
Isolation from AWSS	• Automatic motorized isolation valves would be controlled locally and remotely by the SFFD SCADA system to provide isolation from the existing AWSS. • A manually operated buried valve at the tee connection to the AWSS pipeline would provide isolation between the AWSS and a remote valve vault.
Reduced Fire Flow	• A pressure transmitter upstream of the motorized isolation valve would sense pressure in the recycled water supply system. If the pressure drops below a preset value, it would automatically close the motorized valve.
Line Break Water Loss	• A flow meter would sense when the flow exceeds a preset value which would automatically close the motorized isolation valve. In addition, a pressure transmitter downstream of the meter would sense low pressure and close the motorized isolation valve when the pressure drops below a preset value, indicative of a major line break.
Earthquake	• An earthquake switch could be located in each vault which senses earthquakes above a certain magnitude and automatically closes the motorized isolation valve.
Increased Zone Pressure to Twin Peaks Head	• The pressure transmitter upstream of the motorized isolation valve would sense when the AWSS supply pressure exceeds a preset value which would automatically close the motorized isolation valve.
Normal Pressure Regulation	• Each valve vault would have a pressure regulator which would reduce the downstream pressure to the recycled water users to a preset pressure.
Extreme Pressure Regulation	• Each valve vault would have a pressure relief valve downstream of the pressure regulating valve which would reduce the downstream pressure to the recycled water users in the event that an extreme pressure surge passes the pressure regulating valve.
Manual Bypass	• Each valve would have a manual bypass line controlled by a manual gate valve that would allow the main line to be serviced.

SOURCE: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996.

each service vault to monitor continuously the volume of flow supplied to the storage reservoir and the volume extracted for each user; it could be used to detect leakage of water during normal operation. Each service valve vault would also be equipped with a pressure transmitter which would set an alarm when the pressure both upstream in the AWSS or downstream in the recycled water supply system fall below a pre-determined point. To safeguard the system in the event of an earthquake, each connection vault would be equipped with an earthquake switch to isolate the AWSS during an earthquake above a pre-determined magnitude.

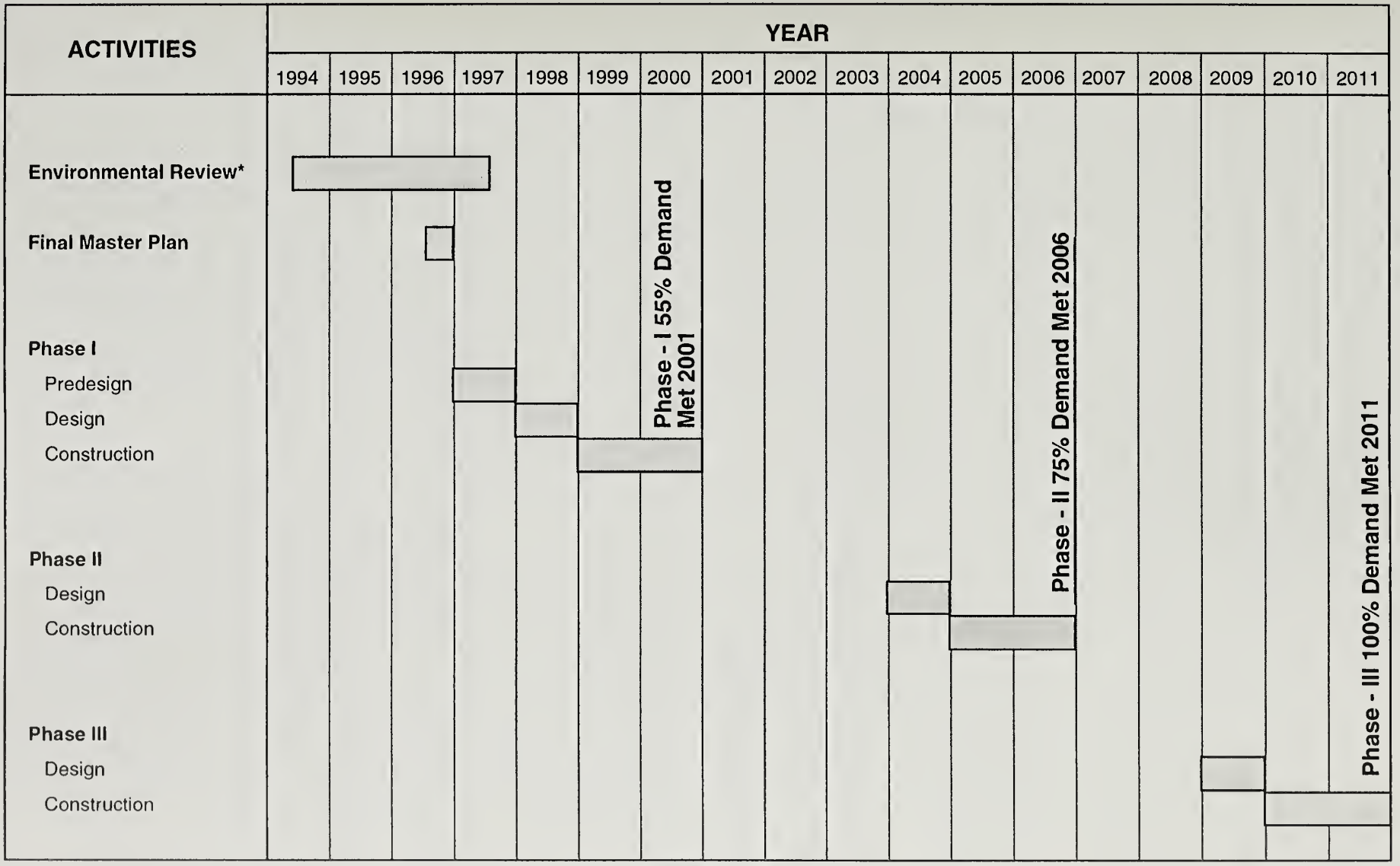
PROJECT IMPLEMENTATION: PHASING, CONSTRUCTION SCENARIO, AND COST

Project Phasing

The construction of the recycled water system is proposed to occur in three phases over approximately a 15-year period. The initial phase would establish the basic infrastructure facilities and would service the major existing identified users on the westside of the city. The subsequent phases would provide recycled water service to the remaining identified users, some of which are not anticipated to be fully developed prior to the final phase (e.g., Mission Bay and Hunters Point), and any additional future users. The distribution system would be expanded over time to meet the projected user demand. The phased program would spread the project costs over several years, making it more affordable to rate payers, and would also provide flexibility to change the plan, if necessary, as determined by future conditions. The proposed phasing of project facilities is also shown in Figure 19 (p. 61), and Figure 12 (p. 40)

Phase 1

Phase 1 would provide the basic recycled water program infrastructure for the western part of the City, including the tertiary treatment plant, the 15-million-gallon Lincoln Reservoir, pump stations, and primary transmission and distribution piping. The Phase 1 facilities would essentially serve all the westside users from the Richmond, Sunset, and Southwest areas. The remaining distribution pipelines would be completed in subsequent phases. The transmission pipe from the tertiary treatment plant to the Southeast Zone McLaren Reservoir would be completed far enough to serve the San Francisco State University and Park Merced. Therefore, in Phase 1 all the Southwest area users around Lake Merced would be served from the Sunset Zone. The estimated demand for Phase 1 is 5.8 mgd average flow (6,500 ac-ft/yr).



* NOTE: Subsequent environmental review would be required for future phases of the RWMP for any facilities outside the scope of this EIR.

SOURCE: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996.

Figure 19
Water Recycling Implementation Schedule

Phase 2

Phase 2 would initiate service to the eastside of the City with construction of the McLaren Reservoir, and a connection pipe to the existing AWSS. The main Southeast Zone transmission pipeline from the tertiary treatment plant is not planned until Phase 3; therefore, a groundwater well would be investigated to supply this zone for the Phase 2 period. The primary users in the Southeast Zone, Hunters Point and Mission Bay, are not anticipated to be fully developed prior to Phase 3.

On the westside, several of the distribution loops would be completed in Phase 2.

Phase 3

During Phase 3, construction of the Recycled Water System would be completed. The primary components of Phase 3 would be completion of the Southeast Zone transmission pipeline from Fleishhacker RWTP site to the McLaren Reservoir, and the distribution loop around Candlestick Park.

Construction Scenario

Table 7 summarizes the RWMP construction scenario and various activities for the proposed treatment plant and three reservoirs. The general construction approach for the treatment plant, reservoirs and pipelines is described below.

Treatment Plant

Construction of the recycled water treatment plant would include the following key stages: excavation and shoring, concrete construction, equipment installation, start up, and testing.

Extensive excavation for the proposed below-ground portions of the plant would be required, including equalization basin, tertiary filters, UV disinfection basin, and recycled water clearwell. The depth of excavation would be about 20 feet below the ground surface. An estimated 47,200 cubic yards of soils would be excavated, and about 10 to 30 percent of it would be used on-site for backfill and possibly for a berm on-site. The remainder of the excavated soils would be hauled off-site for disposal or used as backfill for planned Zoo improvements. Portions of the excavation would be below the estimated groundwater elevation, and construction dewatering would be necessary. A wellpoint and pump system is assumed for the dewatering system.

TABLE 7: SUMMARY OF RWMP CONSTRUCTION SCENARIO AND ACTIVITIES

	RECYCLED WATER TREATMENT PLANT	RESERVOIRS		
Construction Activity	**Fleishhacker Pool**	**Lincoln High School**	**McLaren Park**	
Service area/zone	Citywide	Sunset Zone/Southwest Zone	Southeast Zone	
		(includes pump station)	Site 1	Site 2
Construction Area	5-7 acres	3.5 acres	2.5 acres	3.5 acres
Facility Area	3 acres	2.3 acres	1.5 acres	2 acres
Facility Capacity	15.6 mgd ave day-peak mo. 21.1 mgd peak diurnal	15 mgal	10 mgal	15 mgal
Construction Duration	24 months	8 months	12 months	
Shoring Materials	29,600 sq ft	45,000 sq ft	,39000 sq ft	58,000 sq ft
Excavation	47,200 cu yd	102,000 cu yd	94,000 cu yd	140,000 cu yd
Backfill material	5,000-14,000 cu yd	20,000 cu yd	20,000 cu yd	28,000 cu yd
Concrete materials	10,800 cu yd	14,000 cu yd	9,000 cu yd	13,000 cu yd
Use of excavated material for backfill	10-30% reuse onsite, depending on berm construction	about 20% reuse onsite	about 50-60% reuse onsite for Site 1	about 90-100% reuse onsite for Site 2
Excavated soil material reuse and/or disposal	Some reuse of material at Zoo for wind berm and other planned facilities	Disposal or reuse offsite - either at other construction site or at landfill	Disposal or reuse offsite - either at other construction site or at landfill	
Staging Area for soil and material stockpiling	Onsite	Adjacent to site - Santiago St between 22nd and 24th Ave and northern portion of McCoppin Square	Onsite	
Depth of Excavation	20 feet below the ground surface	28-32 feet below the ground surface	28-32 feet below the ground surface	
Depth to Groundwater	1-2 ft below ground surface	18-32 feet below ground surface	Unknown	
Geotechnical Construction constraints	sandy soils; shallow groundwater	foundation may be in transition from bedrock to native soil	foundation may be in transition from bedrock to native soil	

TABLE 7: SUMMARY OF RWMP CONSTRUCTION SCENARIO AND ACTIVITIES (Continued)

	RWTP	RESERVOIRS	
Construction Activity	**Fleishhacker Pool**	**Lincoln High School**	**McLaren Park**
Groundwater dewatering	Yes, required	Unknown, possible	Unknown, not likely
Method of shoring	Solid shoring; tie back walls; driven or vibrated sheet piles	Drilled soldier piles; driven or vibrated sheet piles; no foundation piles.	Most shoring with drilled soldier piles; some sheet piles for pipelines; no foundation piles.
Construction Access Points	Sloat Boulevard and potential new Hwy 1 entrance	Santiago St & 22nd Ave	Mansell St & John Shelley Dr.
Proposed Haul Routes /1/	Highway 1 Skyline Boulevard, Lake Merced Boulevard, John Muir Drive, Brotherhood Way, I-280	19th Avenue, Santiago Street, Rivera Street, 18th Avenue	U.S. Highway 101, Mansell Street, John A. Shelley Drive or Mansell Street to Visitacion Avenue to Bayshore Blvd.
Crew Size	10-35	10-25	10-25
Construction Traffic			
Total Truckloads	5,000	5,000-6000	1,000-2,000
Average daily truck trips	20 (10 truckloads)	25	25
Peak daily truck trips	100 (50 truckloads)	60	60
Max. AM/PM peak hour truck trips	10	6	6
Max. daily construction worker trips (2.5 x crew size)	88	63	63
Max. AM/PM peak hour worker trips (100% crew size @ peak hour)	35	25	25
Construction Hours/Times	7 am - 5 pm/weekdays	7 am - 5 pm/weekdays possibly Saturday (8 am - 4 pm)	7 am - 5 pm/weekdays

/1/ Actual haul routes will be determined by the San Francisco Department of Parking and Transportation at the time of construction.

SOURCE: Montgomery Watson, 1995 and Environmental Science Associates, 1995.

The excavated area would have vertical side walls formed with solid shoring to stabilize the sandy soils. The shoring system would likely consist of tieback walls. Shoring could also include the use of sheet piles and/or soldier piles in select areas. These are installed either through pile driving or drilling. This type of shoring might be required in a few specific areas. It is expected that installation of this type of shoring might occur at scattered intervals during the 4-6 month earthwork phase for periods of one to two weeks. Additional site-specific geotechnical investigations would be conducted at the site during the project pre-design phase to determine specific dewatering and excavation methods.

Concrete construction for both above ground and underground facilities would require approximately 10,800 cubic yards of steel reinforced concrete. Subsequent to concrete construction, equipment would be delivered and installed, including pump stations, filters, disinfection equipment, electrical and instrumentation facilities, etc. The estimated duration for construction of the tertiary treatment plant is approximately 24 months.

Storage Reservoirs

The two storage reservoirs would be buried concrete structures. They would be constructed in an open excavation with shoring. The depth of excavation would be about 30 feet below the ground surface. About 20 percent of the excavated soil would be returned to the reservoir sites for use as backfill, and the remainder would be transported and disposed of off-site. Excavation and shoring methods would be determined following site-specific geotechnical investigations at each site. Typically, the excavated area would have vertical side walls with solid shoring of soldier piles and lagging with internal bracing or tie back walls or driven or vibrated sheet piles. Base rock and drainage piping would be installed, and the concrete would be cast-in-place, first for the base slab and then for the walls and columns. The concrete would be reinforced with steel rebar and would be used for the base, walls, columns, and roof slab. The top roof slab would then be constructed, and the site would be backfilled to bury the reservoir. School or recreational facilities would then be restored at the surface above the reservoir. The football field and stadium would be rebuilt at Lincoln High School; and grassy field, parking lot or other park facilities (such as a visitors center) would be built at McLaren Park.

The typical construction period for the reservoirs would be about twelve months, although the schedule could be accelerated to eight months at an increased cost. The Lincoln High School Reservoir is proposed to be constructed in eight months, while McLaren Park reservoir is expected to be built in twelve months.

Transmission and Distribution Pipelines

Construction of the recycled water transmission and distribution pipelines would be accomplished using standard construction methods, generally the open cut method (also referred to as cut-and-cover construction method). In most cases, the pipeline would be located within paved roadways and construction would occur segment by segment, usually block-by-block. The rate of progress would be approximately 50 to 200 feet per day, or about one block per week.

The key steps in the construction process would be as follows: (1) surface preparation; (2) trench excavation and shoring; (3) pipe installation; (4) trench backfilling and compacting; and (5) resurfacing of roadway. Surface preparation involves removing any structures (such as fences), saw-cutting and removing pavement or removing vegetation from the surface of the trench area. Equipment used for this activity may include jackhammers, pavement saws, mowers, graders, and loaders. Trench excavation would be done using a backhoe or excavator, and excavated soil of suitable quality would be stockpiled along the trench for later reuse in backfilling the trench. Excess soil would be hauled off-site for disposal. Shoring would be required for trenches more than five feet deep to protect workers from trench failure. Depending on the soil conditions and the depth of excavation, shoring could be done by use of a shield or trench box, steel plates, or sheet piling and beams installed with a pile driver or excavator. Typically, sheet piling would be required for trenches over ten feet deep with unstable soils, such as sand or heavy clay. The pipe would then be installed in the trench, and flexible couplings would be installed between pipe lengths to protect the pipe from damage due to earthquake or other soil movement. The trench would then be backfilled with native soil to the extent possible in order to meet City compaction requirements. However, imported backfill (such as gravel) could be necessary for compactibility and stability. The final step, surface restoration, would involve re-paving with new asphalt or concrete pavement for paved roadways and hauling and disposing of construction debris.[7]

The depth and width of the trench would depend on the size of the pipeline to be installed. For pipe diameters ranging from 8 to 24 inches, the depth of the trench would range from 5 to 8 feet and the width of the trench from 2.5 to 6 feet. There would be a minimum of three feet of cover over any of the pipelines. In some cases where a pipeline would cross a highway, the new pipeline could be elevated above ground and hung beneath an overpass with brackets. If site conditions do not permit open cut construction of a pipeline, trenchless methods, such as jack

[7] City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996.

and boring, could be used; this method would require digging a pit at both ends of the pipeline segment through which the piping installation equipment is inserted and retrieved. Jack and bore methods could be used for crossing under a major intersection, railroad tracks, or freeway to minimize surface disruptions.[8]

Estimated Project Cost

The total capital cost for construction and implementation of the RWMP is estimated to be about $194 million (based on 1999 dollars, which would be the mid-point of the construction schedule). Annual operation and maintenance costs are estimated to be about $4 million per year in the year 2012 after all three phases of the program have been constructed. The total capital cost includes facilities for both water recycling and fire protection, and depending upon the primary function of the system, the total cost of $194 million could be broken down in two ways: (1) if the system were for water recycling with added facilities for fire protection, the costs would be $125 million for water recycling facilities and $69 million for fire protection; and (2) if the system were for fire protection with added facilities for water recycling, the costs would be $124 million for fire protection and $70 million for water recycling.

The breakdown of total estimated project costs by component and phases is shown in Table 8.

PROJECT APPROVALS

Following certification of this EIR by the San Francisco City Planning Commission, a number of project approvals and permits for the RWMP would be required from various agencies.

Table 9 shows the local, state and regional agencies which would be involved in the permit process for the RWMP and each of the proposed facilities.

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[8] Montgomery Watson, *Water Recycling Master Plan Technical Memorandum No. 7, Task 15.1 - Further Define Recommended Alternatives*, April 2, 1993.

TABLE 8: ESTIMATED COST FOR RECYCLED WATER SYSTEM (million dollars, based on ENR 7375)

Project Component	Phase 1	Phase 2	Phase 3	TOTAL
Construction Cost				
Treatment	$ 52.1	$ 0	$ 0	$ 52.1
Storage Reservoirs	16.3	18.7	0	34.9
Distribution	28.0	8.0	16.8	52.9
Pumping	2.2	0	0	2.2
Engineering, Legal, Admin	29.6	8.0	5.1	42.6
DOSD Fee	0.1	0.1	0	0.2
Other Costs /a/	4.0	2.6	1.9	8.5
Art Commission	9.0	0	0	9.0
Total Project Capital Costs	**$ 141.2**	**$ 37.3**	**$ 23.8**	**$ 202.4**
Operation and Maintenance Costs (Annual O/M Cost)				
Treatment	1.7	2.1	2.3	2.3
Storage	0.1	0.2	0.2	0.2
Distribution	0.8	1.0	1.5	1.5
Pumping	0.1	0.1	0.1	0.1
Total Operation and Maintenance Costs	**$ 2.7**	**$ 3.3**	**$ 4.0**	**$ 4.0**
Total Annual Cost	**$ 14.8**	**$ 18.7**	**$21.4**	**$ 21.4**

NOTE: Costs are taken directly from source document, but due to rounding errors, the sum of the components may not equal the total values. The ENR (Engineering News Record) value is a construction cost index for inflation based on geographic location and current dollar value. The ENR index used was for the San Francisco Bay area in July 1995 and then escalated to 1999 assuming a cost index increase of 3 percent annually.

/a/ Offsite mitigation, schedule acceleration, and easement acquisition/lease for storage reservoir sites.

SOURCE: City and County of San Francisco, Department of Public Works, *Recycled Water Master Plan*, Draft, July 1996.

TABLE 9: RECYCLED WATER MASTER PLAN PROJECT APPROVALS

Agency	Authority	RWMP	Fleish-hacker	Lincoln High	McLaren Park	User Sites
Local						
San Francisco Board of Supervisors	Adoption of the Recycled Water Master Plan.	X	X	X	X	X
San Francisco City Planning Commission	Determination of project conformance with objectives and policies of the *San Francisco General Plan.*		X	X	X	X
	Issuance of Coastal Development Permit and determination of consistency with Local Coastal Program (pursuant to authority delegated by the California Coastal Commission).		X			
San Francisco Art Commission	Approval of exterior design of proposed facilities in accordance with Section 3.13 of the *San Francisco Administrative Code.*		X			
San Francisco Fire Commission	Approval to use the Auxiliary Water Supply System (AWSS) for joint use of system with recycled water distribution.		X	X	X	X
San Francisco Bureau of Light, Heating and Power	Approval to connect proposed facilities to PG&E's power grid.		X	X	X	
San Francisco Recreation and Park Commission	Determination of consistency of proposed project facilities with park use.		X		X	X
San Francisco Unified School District	Approval of use of property under its jurisdiction.			X		X
San Francisco Voters	Approval of project facilities within City parks if Rec Park Commission determines use inconsistent.		X		X	
State and Regional						
Bay Area Air Quality Management District	Permit required indicating project conformance with the State Health and Safety code and relevant District regulations.		X			
Regional Water Quality Control Board	Waste Discharge Requirements Water Recycling Permit.		X			X
California Department of Health Services	Review of Water Recycling Permit.		X			X

SOURCE: Environmental Science Associates and Orion Environmental Associates, 1996.

B. GROUNDWATER MASTER PLAN

PROJECT OVERVIEW

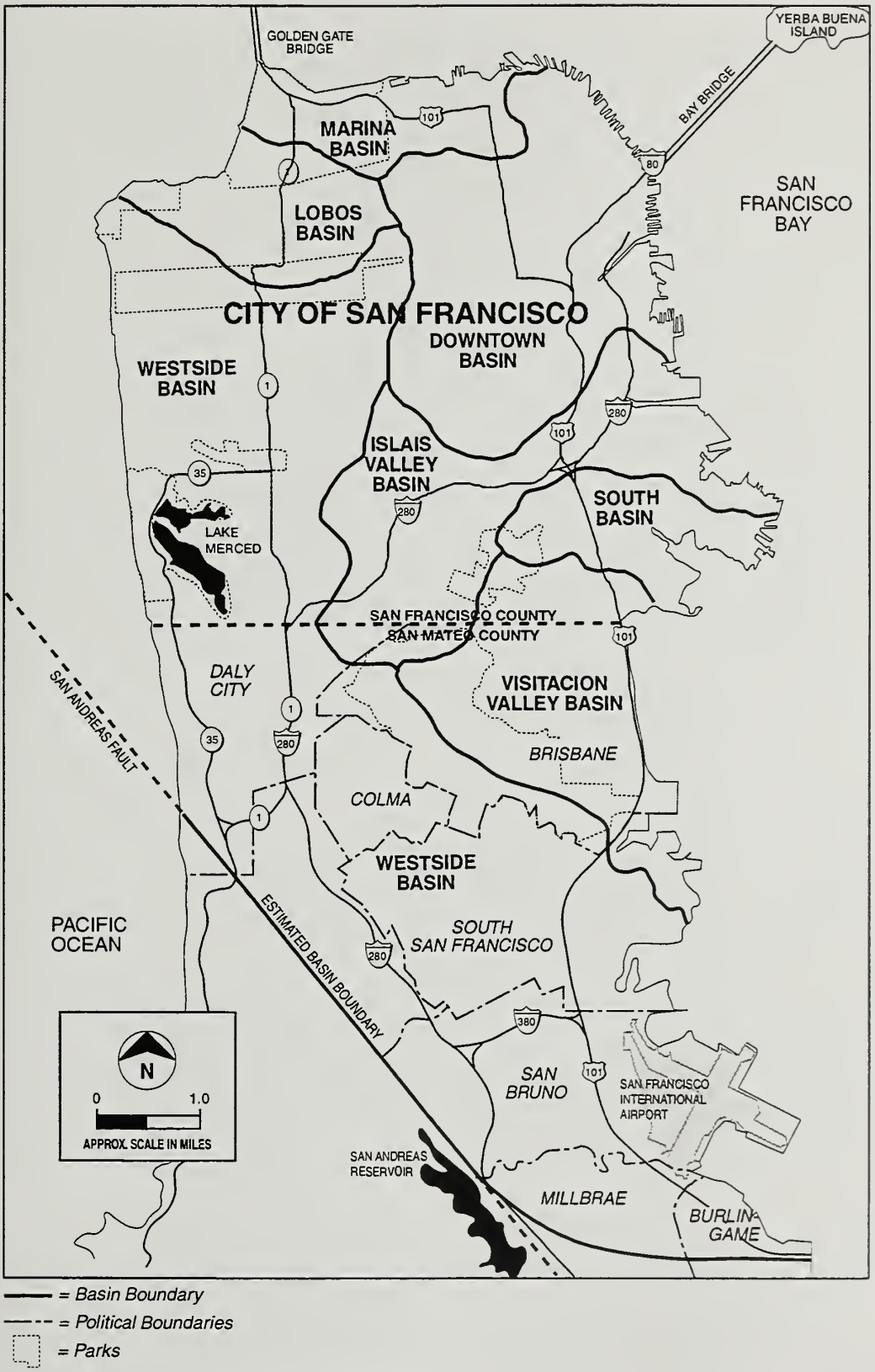
The Groundwater Master Plan (GWMP) contains the San Francisco Water Department (SFWD) plans to evaluate, manage, and develop local groundwater resources. The SFWD has prepared the GWMP pursuant to City Resolution 389-89 and Ordinances 390-91 and 391-91, which were adopted by the Board of Supervisors. The GWMP is described in summary fashion in this document. A complete GWMP may be obtained directly from the SFWD, or reviewed at the Planning Department offices, as a part of the environmental review file for this project.

Seven groundwater basins occur either wholly or partially beneath San Francisco County: the Westside, Lobos, Marina, Downtown, Islais Valley, South, and Visitacion Valley basins (see Figure 20). The GWMP identifies five basic goals, as well as a variety of long-term strategies and short-term activities for the purpose of evaluating, managing and developing those groundwater resources.

As defined in the GWMP, "goals" are "the Water Department's ultimate purpose in managing, developing and using local groundwater"; "long-term strategies" are "management practices and techniques to guide activities to be implemented over the next 20 years toward meeting those goals"; and "short-term activities" are "specific activities to be conducted within the next 5 years to begin management, development, and use of groundwater. These include both constructible projects and program development, as well as additional studies to define subsequent activities."

A summary of these goals, strategies and activities is presented in Figures 21 and 22. The relationship of the short term activities to the specific groundwater basins is presented in Figures 23 and 24, and the implementation schedule for short-term activities is presented in Figures 25 and 26.

Following is a brief discussion presenting some background information regarding groundwater resources and use. Following that material is a summary presentation of the specific goals, strategies and activities included within the GWMP. The information presented herein is intended to provide the reader with a background sufficient to allow for an understanding of the environmental impact analysis which follows. The reader is reminded that more detailed information describing each goal, strategy and activity may be found in the GWMP, itself.



SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

SF RWMP/GWMP Program EIR ■

Figure 20
Groundwater Basins and City/County Jurisdictions

Goal	Long-Term Strategy	Short-Term Activity
1. Protect and Enhance Groundwater Quality	1A Prevent saltwater intrusion	1A1 Evaluate potential for saltwater intrusion 1A2 Develop and implement a saltwater intrusion prevention network
	1B Reduce risk of future groundwater contamination	1B1 Develop and implement a wellhead protection program
	1C Increase hydrologic data regarding City's groundwater resource	1C1 Develop and implement a groundwater monitoring program
2. Coordinate Groundwater Use	2A Establish Water Department as lead in City groundwater management	2A1 Establish a Groundwater Management Unit within the Water Department
	2B Improve coordination with other government agencies regulating/affecting groundwater use within the City	2B1 Form a City groundwater management committee
	2C Improve coordination with adjacent entities whose groundwater use affects shared groundwater basins	2C1 Form appropriate AB 3030 management committee(s)
	2D Enhance communication with Water Department customers	2D1 Develop and implement a public information program
3. Protect and Conserve Related Water Resources	3A Manage lake water levels	3A1 Conduct additional field investigation at Lake Merced 3A2 Conduct modeling to estimate effects of specific groundwater pumping patterns on Lake Merced water levels 3A3 Evaluate relationship between other City lakes and groundwater 3A4 Develop and implement policies and procedures to manage water levels in City lakes
	3B Manage stream water levels	3B1 Assess effects of groundwater development on Lobos Creek 3B2 Evaluate relationship between other City streams and groundwater 3B3 Develop and implement procedures to manage water levels in City streams

SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

SF RWMP/GWMP Program EIR ■

Figure 21

Summary of GWMP Goals, Long-Term Strategies, and Short-Term Activities for Groundwater Management

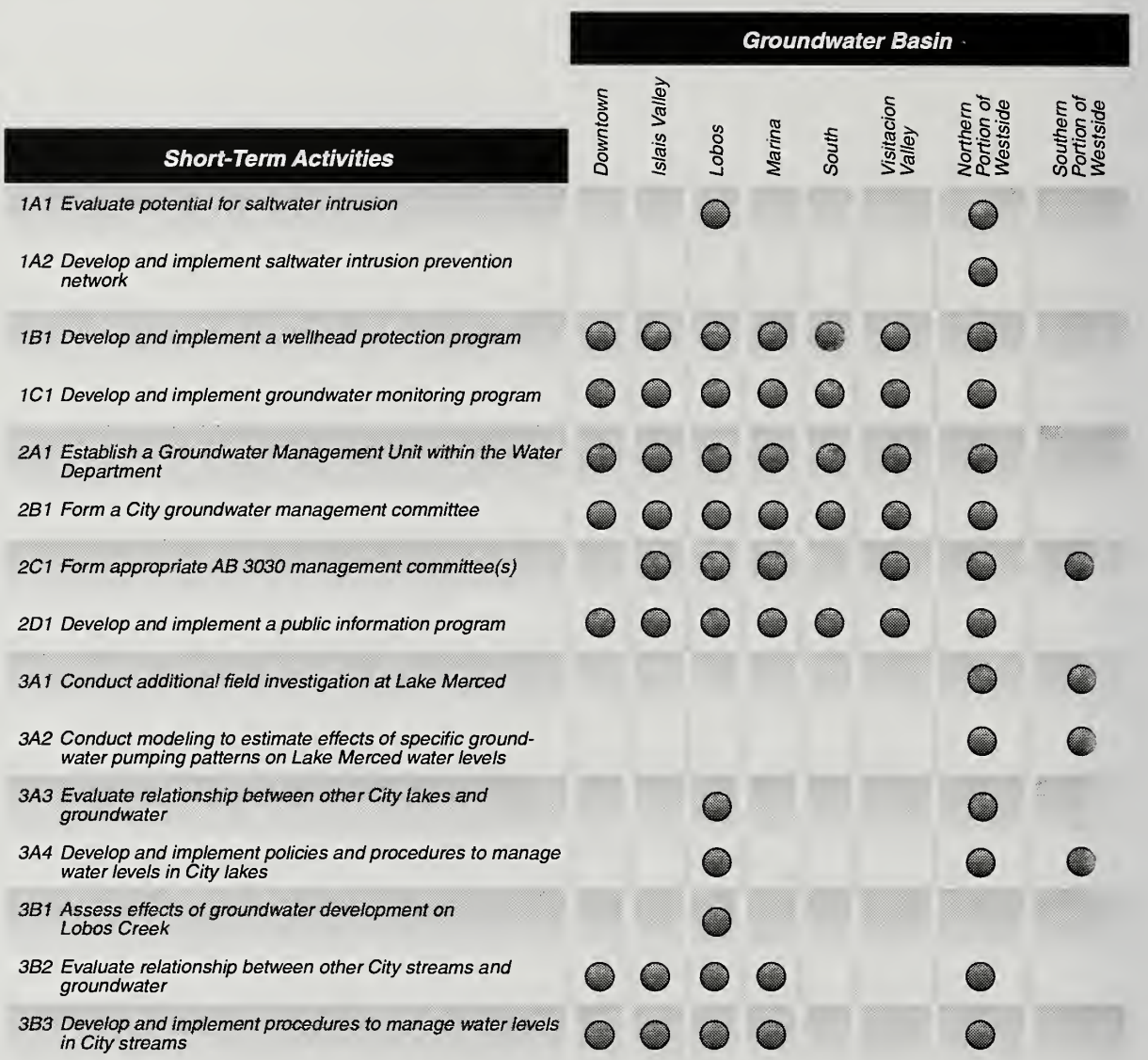
Goal	Long-Term Strategy	Short-Term Activity
4. Improve Ability to Deliver Water During Emergencies	4A Evaluate use of groundwater as an emergency reserve	4A1 Study the feasibility of installing large-capacity standby wells 4A2 Design, install and operate large-capacity standby wells, if appropriate 4A3 Update the Water Department's Emergency Operations Plan
5. Maximize Groundwater Use	5A Capture groundwater outflow to the San Francisco Bay or Pacific Ocean	5A1 Extract groundwater from Elk Glen Well; add to main distribution system 5A2 Extract groundwater from the Sunset District, add to main distribution system
	5B Capture groundwater produced by dewatering operations	5B1 Add groundwater to the AWSS from dewatering at the Powell Street BART 5B2 Identify permanent dewatering operation in the City and identify potential beneficial uses for the water 5B3 Develop procedures to put temporary construction dewatering water to beneficial use 5B4 Evaluate the feasibility of using, and implement if appropriate, the existing sludge line to convey non-potable water to the North Point plant
	5C Operate groundwater basins conjunctively	5C1 Conduct in-lieu recharge of the southern portion of the Westside Basin 5C2 Conduct conjunctive use in the Lobos Basin
	5D Investigate other groundwater basins	5D1 Develop and implement a study of the Lobos Basin 5D2 Develop and implement studies of other shared and City basins
	5E Evaluate other potential activities for increasing groundwater use	5E1 Evaluate, and implement where feasible, potential groundwater use in the City's fountains and decorative pools 5E2 Evaluate, and implement where feasible, the potential for groundwater to help control corrosion in the City's water distribution system

SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

SF RWMP/GWMP Program EIR ■

Figure 22

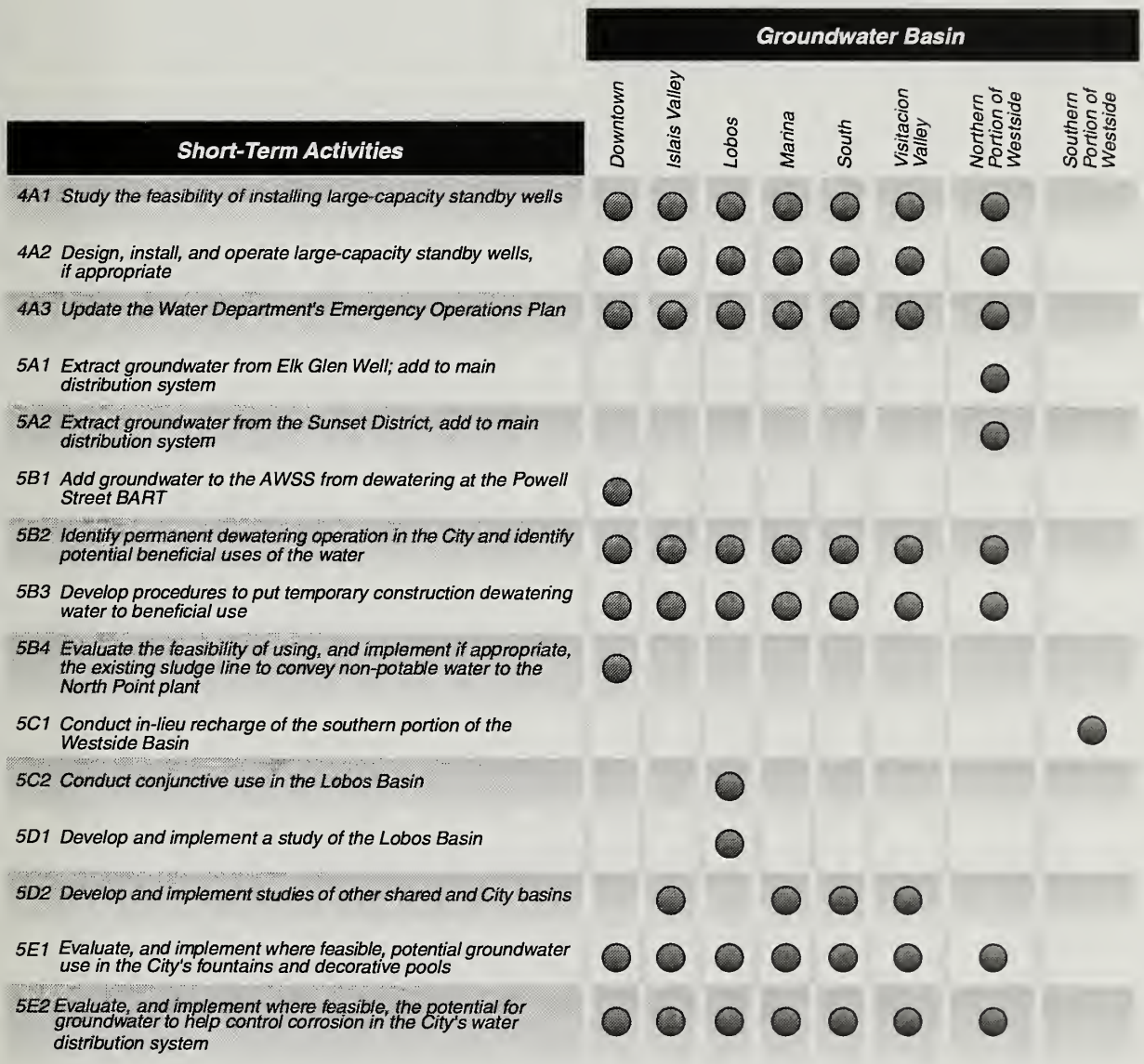
Summary of GWMP Goals, Long-Term Strategies, and Short-Term Activities for Groundwater Development and Use


Groundwater Basin
Short-Term Activities
Downtown
Islais Valley
Lobos
Marina
South
Visitacion Valley
Northern Portion of Westside
Southern Portion of Westside
1A1 Evaluate potential for saltwater intrusion
1A2 Develop and implement saltwater intrusion prevention network
1B1 Develop and implement a wellhead protection program
1C1 Develop and implement groundwater monitoring program
2A1 Establish a Groundwater Management Unit within the Water Department
2B1 Form a City groundwater management committee
2C1 Form appropriate AB 3030 management committee(s)
2D1 Develop and implement a public information program
3A1 Conduct additional field investigation at Lake Merced
3A2 Conduct modeling to estimate effects of specific groundwater pumping patterns on Lake Merced water levels
3A3 Evaluate relationship between other City lakes and groundwater
3A4 Develop and implement policies and procedures to manage water levels in City lakes
3B1 Assess effects of groundwater development on Lobos Creek
3B2 Evaluate relationship between other City streams and groundwater
3B3 Develop and implement procedures to manage water levels in City streams

SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

SF RWMP/GWMP Program EIR ■

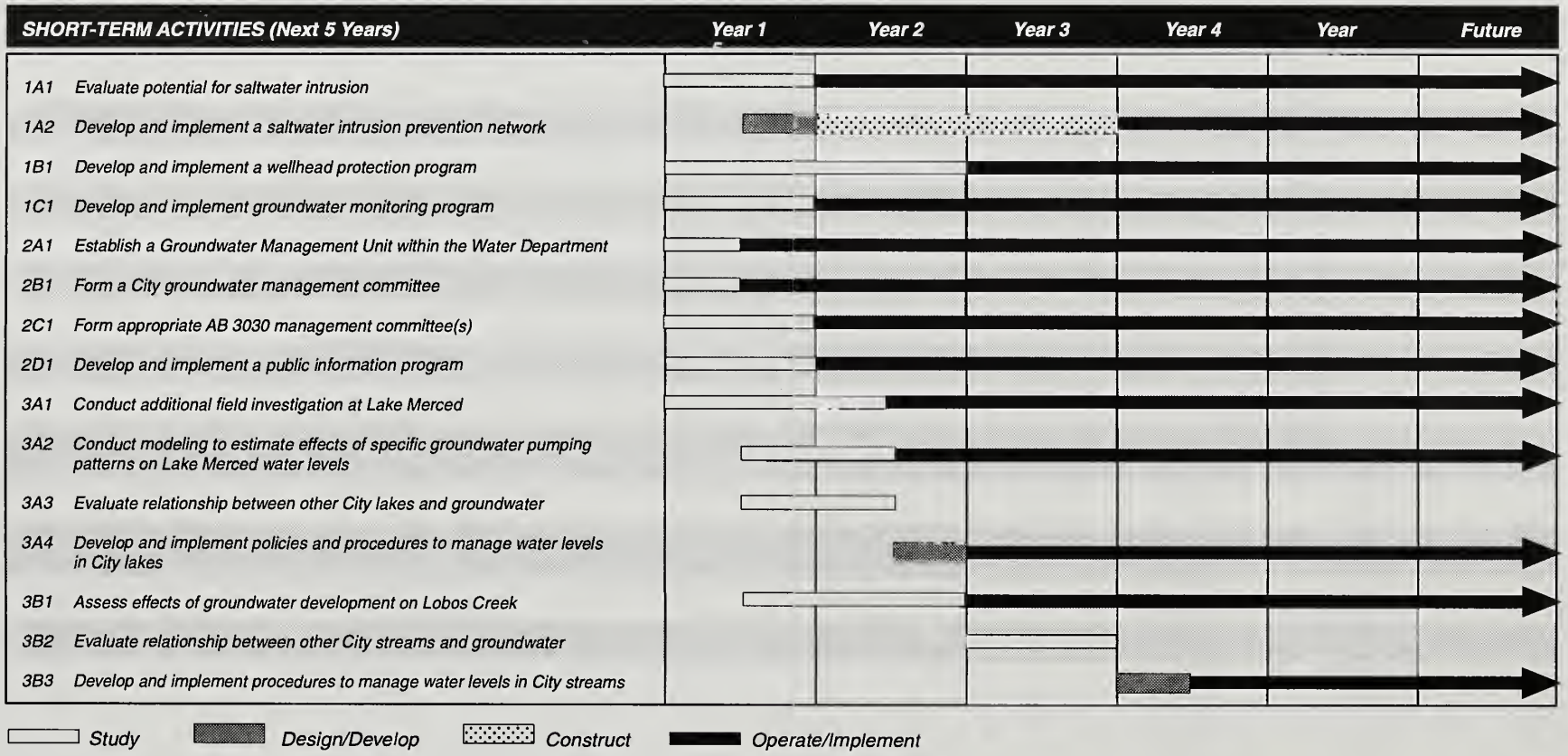
Figure 23
Groundwater Management
Short-Term Activities by Groundwater Basin


Groundwater Basin
Short-Term Activities
Downtown
Islais Valley
Lobos
Marina
South
Visitacion Valley
Northern Portion of Westside
Southern Portion of Westside
4A1 Study the feasibility of installing large-capacity standby wells
4A2 Design, install, and operate large-capacity standby wells, if appropriate
4A3 Update the Water Department's Emergency Operations Plan
5A1 Extract groundwater from Elk Glen Well; add to main distribution system
5A2 Extract groundwater from the Sunset District, add to main distribution system
5B1 Add groundwater to the AWSS from dewatering at the Powell Street BART
5B2 Identify permanent dewatering operation in the City and identify potential beneficial uses of the water
5B3 Develop procedures to put temporary construction dewatering water to beneficial use
5B4 Evaluate the feasibility of using, and implement if appropriate, the existing sludge line to convey non-potable water to the North Point plant
5C1 Conduct in-lieu recharge of the southern portion of the Westside Basin
5C2 Conduct conjunctive use in the Lobos Basin
5D1 Develop and implement a study of the Lobos Basin
5D2 Develop and implement studies of other shared and City basins
5E1 Evaluate, and implement where feasible, potential groundwater use in the City's fountains and decorative pools
5E2 Evaluate, and implement where feasible, the potential for groundwater to help control corrosion in the City's water distribution system

SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

SF RWMP/GWMP Program EIR ■

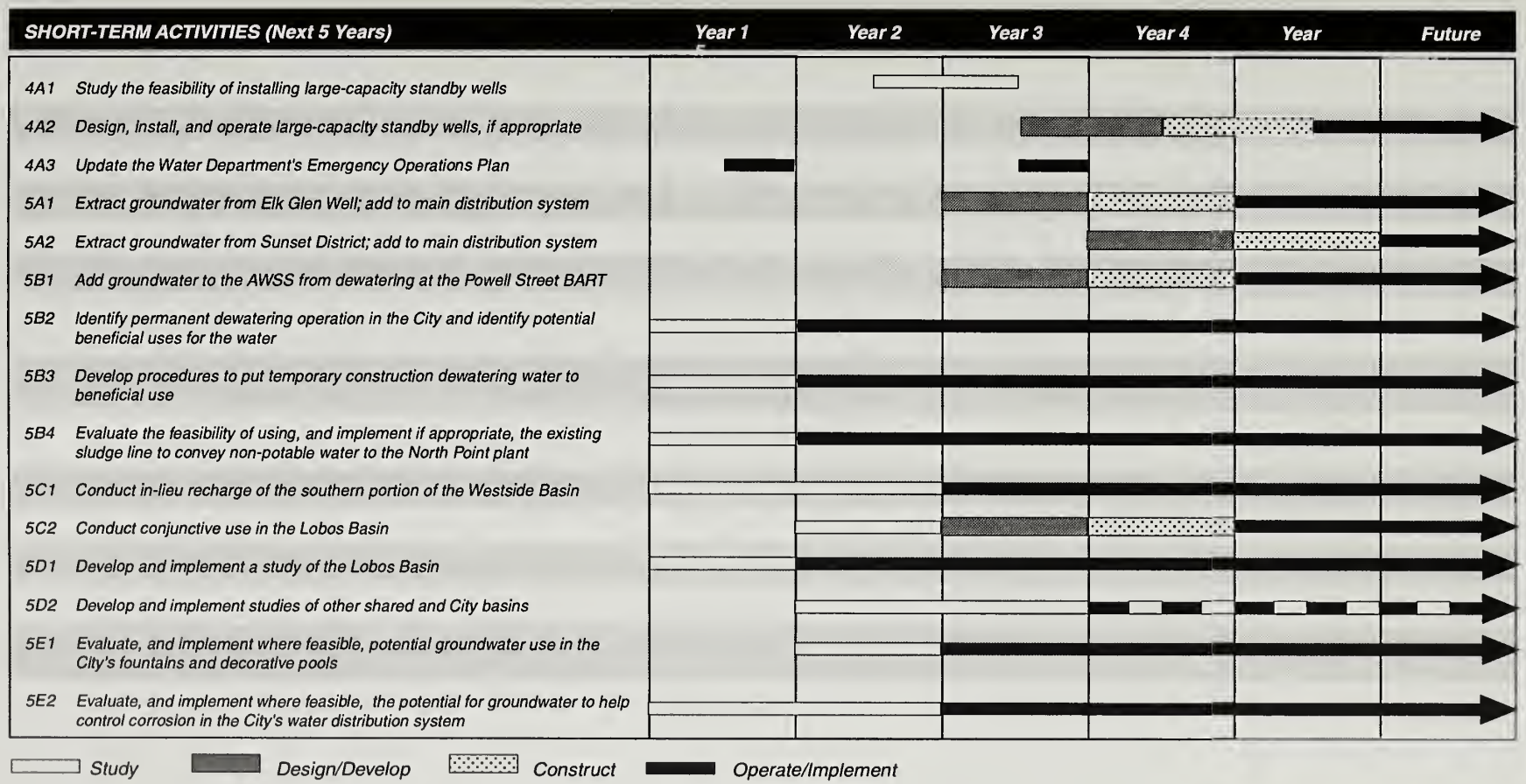
Figure 24
Groundwater Development and Use
Short-Term Activities by Groundwater Basin


SHORT-TERM ACTIVITIES (Next 5 Years)
Year 1
Year 2
Year 3
Year 4
Year
Future
1A1 Evaluate potential for saltwater intrusion
1A2 Develop and implement a saltwater intrusion prevention network
1B1 Develop and implement a wellhead protection program
1C1 Develop and implement groundwater monitoring program
2A1 Establish a Groundwater Management Unit within the Water Department
2B1 Form a City groundwater management committee
2C1 Form appropriate AB 3030 management committee(s)
2D1 Develop and implement a public information program
3A1 Conduct additional field investigation at Lake Merced
3A2 Conduct modeling to estimate effects of specific groundwater pumping patterns on Lake Merced water levels
3A3 Evaluate relationship between other City lakes and groundwater
3A4 Develop and implement policies and procedures to manage water levels in City lakes
3B1 Assess effects of groundwater development on Lobos Creek
3B2 Evaluate relationship between other City streams and groundwater
3B3 Develop and implement procedures to manage water levels in City streams
Study
Design/Develop
Construct
Operate/Implement

SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

SF RWMP/GWMP Program EIR ■

Figure 25
Implementation Schedule for Short-Term Groundwater Management Activities


SHORT-TERM ACTIVITIES (Next 5 Years)
Year 1
Year 2
Year 3
Year 4
Year
Future
4A1 Study the feasibility of installing large-capacity standby wells
4A2 Design, Install, and operate large-capacity standby wells, if appropriate
4A3 Update the Water Department's Emergency Operations Plan
5A1 Extract groundwater from Elk Glen Well; add to main distribution system
5A2 Extract groundwater from Sunset District; add to main distribution system
5B1 Add groundwater to the AWSS from dewatering at the Powell Street BART
5B2 Identify permanent dewatering operation in the City and identify potential beneficial uses for the water
5B3 Develop procedures to put temporary construction dewatering water to beneficial use
5B4 Evaluate the feasibility of using, and implement if appropriate, the existing sludge line to convey non-potable water to the North Point plant
5C1 Conduct in-lieu recharge of the southern portion of the Westside Basin
5C2 Conduct conjunctive use in the Lobos Basin
5D1 Develop and implement a study of the Lobos Basin
5D2 Develop and implement studies of other shared and City basins
5E1 Evaluate, and implement where feasible, potential groundwater use in the City's fountains and decorative pools
5E2 Evaluate, and implement where feasible, the potential for groundwater to help control corrosion in the City's water distribution system
Study
Design/Develop
Construct
Operate/Implement

SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

SF RWMP/GWMP Program EIR ■

Figure 26
Implementation Schedule for Short-Term Groundwater Development and Use Activities

Following the summary of the GWMP is further information regarding types of potential actions and projects, some specific proposed projects, and the GWMP implementation schedule and cost.

GROUNDWATER RESOURCES AND USE - BACKGROUND

Groundwater resources in the seven basins beneath the City (including three basins that extend beyond city boundaries) were investigated as part of the GWMP development process to assess the potential to increase groundwater use. Based on assumptions regarding the thickness of the aquifer in each basin and on groundwater elevation data collected during the 1987-1992 drought (the only period with adequate data), the City anticipates that the groundwater basins may be able to yield additional water supply. Although there remain information gaps regarding the hydrology of all the groundwater basins, Table 10 presents known information about each basin and indicates the potential for development of additional groundwater resources in each basin.

For each groundwater basin, Table 10 shows an estimate of the average annual rate of recharge. Recharge rate is a measure of the amount of water entering a groundwater basin, and includes the following potential sources: rainfall, irrigation water, leaking underground pipes, groundwater inflow and stream leakage. The recharge rate provides an indication of the capacity and safe yield of a groundwater basin under current recharge and discharge conditions. As part of the GWMP, modification of recharge and discharge would be evaluated to maximize the safe yield of a basin.

Based on the basin characteristics, such as aquifer thickness, susceptibility to subsidence and saltwater intrusion, known water quality conditions, and historic groundwater levels, a qualitative assessment of the development potential for each basin was developed. The aquifer thickness indicates the potential volume of groundwater storage and whether groundwater extraction could occur from multiple intervals within the aquifer; a thicker aquifer increases development potential. Basins with sediments that have a high clay content, such as those found in the Downtown and Marina basins, make an area susceptible to subsidence and constrain the groundwater development potential. Groundwater development may also be limited in basins adjacent to saltwater bodies because of potential for salt water intrusion. All seven groundwater basins lie adjacent to either the Pacific Ocean or San Francisco Bay, and thus saltwater intrusion is a potential concern.

TABLE 10: SUMMARY OF GROUNDWATER RESOURCES

Basin	Estimated Average Annual Recharge (ac-ft/yr)/a,b/	Development Potential	Likely Groundwater Quality/c/	Amount of Groundwater Extracted from Basin (1993)/d/ (ac-ft/yr)	Amount of Groundwater Extracted from Basin (1993)/d/ (mgd)
Westside	14,800 /e/	High	Potable	~13,800	12.3/f/
Lobos	1,600	Medium	Potable	2,300/g/	2.0
Marina	1,300	Low (High Subsidence Potential)	Unknown	Unknown	--
Downtown	5,900	Medium-Low (High Water Levels, High Subsidence Potential)	Non-Potable	1,500	1.3
Islais Valley	1,800	Insufficient data	Unknown	Unknown	--
South	700	Insufficient data	Unknown	200	0.2
Visitacion Valley	Unknown	Insufficient data	Unknown	Unknown	--

/a/ Recharge estimates are based on USGS data (Phillips et al., 1993), except for data from the portion of the Westside Basin south of the county line. USGS data were collected for 1987 and 1988, the first years of a 6-year drought. Recharge estimates have been rounded to the nearest 100 acre-feet.

/b/ Recharge includes leakage from underground pipes, which has not been specifically quantified. It can be assumed that this source of recharge will decrease in the future as repairs to the system are made.

/c/ Potential sources of groundwater contamination exist in each basin. Where groundwater quality conditions are known, a preliminary assessment of the potable or non-potable water quality is shown.

/d/ Numbers are estimates based on City and Bay Area Water Users Association records. Estimates may be low because pumping records are incomplete (no requirement for reporting exists).

/e/ Includes recharge of both the northern and southern portions of the Westside Basin. Applied Consultants (1991) estimated the average annual recharge to the southern portion of the Westside Basin to be 9,970 ac-ft/yr. Phillips et al. (1993) estimated the average annual recharge to the northern portion of the Westside Basin to be 4,900 ac-ft/yr.

/f/ Extraction estimate based on Bay Area Water Users Association estimates of 7.3 mgd municipal use and 3 mgd non-municipal use and Water Department estimate of 2 mgd use.

/g/ Lobos Creek flow (1,800 ac-ft/yr) plus documented groundwater extraction (530 ac-ft/yr). Additional evaluation is necessary to determine whether the recharge and extraction numbers accurately represent Lobos Basin conditions.

SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996.

Table 10 (p. 79) also presents the estimated total amount of groundwater extracted from each basin in 1993. The difference between the estimated average annual recharge and the amount extracted gives an indication of the maximum additional amount of groundwater that could be withdrawn from the basin during an average rainfall year. Because withdrawing the maximum amount of groundwater without increasing recharge could potentially induce undesirable effects (such as saltwater intrusion or subsidence), the full withdrawal of this amount is not planned to occur under current recharge and discharge conditions.

The Water Department's qualitative assessment of potential groundwater quality is based on historical and recent water quality sampling results collected from a variety of locations within the basins, as well as a general overview of the number of known sites with hazardous waste contamination within the basins. The sampling data provide an overview of the likely water quality within each basin, giving a general indication of whether the groundwater is expected to be potable or non-potable. The hazardous waste contamination sites are based on published regulatory agency lists, which typically give a general indication of the nature and extent of contamination and if the site has been remediated (these records are not always complete or current). This published information also provides a general indication of groundwater quality. Prior to actual well development for groundwater extraction, further analysis would be necessary to determine site specific, local water quality.

Groundwater in the southern portion of the Westside Basin and Lobos Basin is currently used for potable purposes and is routinely sampled and analyzed for compliance with drinking water standards. The groundwater in these basins is therefore considered potable. Groundwater in the northern portion of the Westside Basin is also considered potable based on preliminary sampling results obtained during the winter of 1993 from ten locations in the basin. In the Downtown Basin, groundwater quality is considered non-potable based on the results of 18 water samples collected in 1993, the number of known hazardous waste sites, and the history of industrial development.

Based on the available information, the Westside Basin currently appears to have the highest development potential, followed by the Lobos Basin. Groundwater in the Lobos Basin has been historically developed for potable use by the U.S. Army at the Presidio Army Base, but is currently not being extracted for potable uses until completion of the water treatment plant rehabilitation. With the decommissioning of the Presidio as an army facility and its creation as a National Park (October 1994), the City has initiated discussions with the National Park Service

about coordinating water demands and supplies to protect the Lobos Basin groundwater resource and to maintain and restore related environmental resources (such as lakes and streams).

In the Marina, South, Visitacion, and Islais Valley basins, groundwater is generally undeveloped, and information on hydrogeologic properties and water quality is limited. The Marina Basin has a high subsidence potential. Given the history of industrial use in the southeast part of the City, the South, Visitacion, and Islais Valley basins have a greater potential for contamination. However, evaluation of the development potential of groundwater in these basins requires additional data collection and user surveys. Although these basins are not likely candidates for short-term development, the potential for long-term development would be assessed after the additional studies have been completed.

GROUNDWATER MASTER PLAN - GOALS, STRATEGIES AND ACTIVITIES

The GWMP consists of goals, strategies and activities to evaluate, manage, and develop local groundwater resources, as described below. The first three goals are management goals developed to protect and manage the City's groundwater as a long-term resource. The last two goals are generally related to groundwater development and use.

Goal 1: Protect and Enhance Groundwater Quality

Long-Term Strategy 1A: Prevent Saltwater Intrusion. As groundwater is pumped from a well, underground saltwater from adjacent saltwater bodies (Pacific Ocean or San Francisco Bay) could migrate landward within the aquifer, and if extraction rates exceed the recharge rates, the saltwater could eventually degrade the quality of water extracted from the well. Two short-term activities to prevent saltwater intrusion are proposed.

> *Short-Term Activity 1A1: Evaluate Potential for Saltwater Intrusion.* The SFWD proposes to use a Saltwater Intrusion Model, developed based upon existing hydrogeologic data, to analyze potential for saltwater intrusion and to refine the model as additional hydrogeologic data are collected.
>
> *Short-Term Activity 1A2: Develop Saltwater Intrusion Prevention Network.* A groundwater monitoring and contingency plan would be developed by SFWD, and would contain the following components: monitoring well locations; water sampling parameters/procedures; specific actions and action levels for implementation of contingency plans. The potential use of injection wells and injection water sources would also be considered.

Long-Term Strategy 1B: Reduce Risk of Future Groundwater Contamination. To prevent degradation of groundwater quality beneath areas intended for or with already developed groundwater use, existing and potential groundwater pollution sources in these areas would be managed to reduce the risk of future groundwater pollution.

> *Short-Term Activity 1B1: Develop and Implement a Wellhead Protection Program.* A wellhead protection program is intended to protect water quality, generally by identifying sources of potential contamination, and reducing the risk of groundwater contamination. The SFWD proposes to develop a wellhead protection program, which would include components such as: delineating protection areas; identifying potential contamination sources; establishing monitoring and reporting procedures regarding water use; developing contingency plans for emergency response; coordinating with the San Francisco Department of Public Health, and the Regional Water Quality Control Board; and establishing a program of enforcement actions against entities responsible for contamination.

Long-Term Strategy 1C: Increase Hydrologic Data Regarding City's Groundwater Resources. Long-term monitoring and analysis of groundwater quality, groundwater levels, and extraction rates would be necessary in order to create a reliable groundwater data base needed to manage the groundwater basins over the long term.

> *Short-Term Activity 1C1: Develop and Implement Groundwater Monitoring Program.* The SFWD would develop a monitoring program and produce a groundwater data base for each of the City's seven groundwater basins. At a minimum, the data base would include information on water quality, water levels, and water extraction.

Goal 2: Coordinate Groundwater Use

Long-Term Strategy 2A: Establish Water Department as Lead in City Groundwater Management. The SFWD would be designated as the lead agency in the City, responsible for implementing the long-term strategies and short-term activities identified in the GWMP.

> *Short-Term Activity 2A1: Establish a Groundwater Management Unit Within the Water Department.* The SFWD would form an internal Groundwater Management Unit, responsible for the following: implementing GWMP activities; developing new strategies and activities; maintaining and updating data bases; implementing monitoring programs; implementing permitting programs; inter-agency coordination; public contact; and monitoring local, state and federal legislation.

Long-Term Strategy 2B: Improve Coordination with Other Government Agencies Regulating/Affecting Groundwater Use Within the City. The SFWD recognizes the need to coordinate the actions and/or policies of the various agencies that currently have a role in

projects or other activities that may affect groundwater. Those agencies are: the San Francisco Departments of Public Works, Recreation and Parks, Planning, Building Inspection, Public Health, and the Fire Department; the California Department of Health Services and the Regional Water Quality Control Board; and the United States Environmental Protection Agency and National Park Service.

> *Short-Term Activity 2B1: Form a City Groundwater Management Committee.* The SFWD proposes to establish a committee of representatives from the above-listed agencies, in order to improve coordination and clarify responsibilities and authority.

Long-Term Strategy 2C: Improve Coordination with Adjacent Entities Whose Groundwater Use Affects Shared Groundwater Basins. The City shares portions of the Westside, Islais Valley and Visitacion Valley basins with jurisdictions south of the City boundary. Portions of the Marina and Lobos basins are shared with the National Park Service. The SFWD recognizes that effective groundwater basin management must include coordination with those other jurisdictions.

> *Short-Term Activity 2C1: Form Appropriate AB 3030 Management Committees.* Assembly Bill (AB) 3030 was passed by the California State Legislature in 1992 to encourage local public water agencies and other appropriate entities to jointly manage shared groundwater basins. The SFWD, the California Water Service and the cities of Daly City and San Bruno are working together to prepare an AB 3030 plan for the development and management of the Westside Basin.

Long-Term Strategy 2D: Enhance Communication with Water Department Customers. The SFWD would develop a public involvement program to foster customer understanding of the strategies and activities described in the GWMP.

> *Short-Term Activity 2D1: Develop and Implement a Public Information Program.* The SFWD proposes to develop a public information program that would involve activities such as: centralizing the SFWD's interactions with the public; designating a SFWD member as spokes-person; identifying customer groups that need special involvement efforts; and distributing fact sheets and bulletins.

Goal 3: Protect and Conserve Related Water Resources

Long-Term Strategy 3A: Manage Lake Water Levels. Lakes within the City serve as emergency water supplies and wildlife habitats, and are used for recreation. Use of groundwater could affect water levels in lakes. This strategy expresses the SFWD objective of maintaining City lakes at levels that meet the balanced requirements of the potential uses.

Short-Term Activity 3A1: Conduct Additional Field Investigation at Lake Merced. The SFWD has begun to collect data in order to understand the hydrology of Lake Merced, as it relates to the Westside Basin. Additional data and analysis are required for better understanding of the hydrologic system. The GWMP proposes additional monitoring wells, data collection and analysis, with the objective of developing groundwater management alternatives for the Lake Merced area. These activities, in part, are in response to Resolution 95-0082, adopted on May 23, 1995 by the Public Utilities Commission, which expressed the Commission's desire to halt the decline in Lake Merced water levels, and directed staff to take the necessary steps to gather information and develop plans and/or actions to accomplish that goal.

Short-Term Activity 3A2: Conduct Modeling to Estimate Effects of Specific Groundwater Pumping Patterns on Lake Merced Water Levels. Using data from Activity 3A1, the SFWD plans to expand the existing hydrologic model of Lake Merced, and to evaluate the potential effects of different recharge and pumping scenarios on Lake levels.

Short-Term Activity 3A3: Evaluate Relationship Between Other City Lakes and Groundwater. The SFWD plans to survey other lakes and surface water features in the City to evaluate the relationship between those features and the local groundwater.

Short-Term Activity 3A4: Develop and Implement Policies and Procedures to Manage Water Levels in City Lakes. Based upon evaluation of modeling results, SFWD would implement policies and procedures to manage water levels in City lakes.

Long-Term Strategy 3B: Manage Stream Water Levels. At present, the only free-flowing creek in the City is Lobos Creek. The SFWD would include stream management as part of its long-term management of the City's groundwater basins.

Short-Term Activity 3B1: Assess Effects of Groundwater Development on Lobos Creek. Lobos Creek is managed by the National Park Service. The SFWD proposes to work with the National Park Service to study Lobos Creek, the Lobos Basin, and the interrelationship between the two. This activity would use the results of the study proposed in Activity 5D1 (see below).

Short-Term Activity 3B2: Evaluate Relationship Between Other City Streams and Groundwater. The SFWD would investigate other City streams (now filled) in order to evaluate the relationship between those streams and the groundwater basins. Those studies could also support stream restoration efforts.

Short-Term Activity 3B3: Develop and Implement Policies and Procedures to Manage Water Levels in City Streams. Based upon information derived from activities 3B1 and 3B2, the SFWD would develop and implement policies and procedures to manage water levels within City streams.

Goal 4: Improve Ability to Deliver Water During Emergencies

Long-Term Strategy 4A: Evaluate Use of Groundwater as an Emergency Reserve. The SFWD's ability to supply water to customers is at risk during emergency situations, such as an earthquake, which could damage transmission lines. The City proposes to evaluate the use of groundwater as a potential emergency water supply.

Short-Term Activity 4A1: Study the Feasibility of Installing Large-Capacity Standby Wells. The SFWD proposes to evaluate the feasibility of installing large-capacity groundwater wells, which would generally remain inactive, but would be available for use during emergencies.

Short-Term Activity 4A2: Design, Install, and Operate Large-Capacity Standby Wells, if Appropriate. Depending upon the results of the studies undertaken pursuant to Activity 4A1, the SFWD could propose large-capacity standby emergency wells for construction.

Short-Term Activity 4A3: Update the Water Department's Emergency Operations Plan. Depending upon the results of Activities 4A1 and 4A2, the SFWD's existing Emergency Operations Plan could be revised to reflect changes in the City's emergency water supply.

Goal 5: Maximize Groundwater Use

Long-Term Strategy 5A: Capture Groundwater Outflow to the San Francisco Bay or Pacific Ocean. Annual recharge of the groundwater basins is provided through natural (rainfall) and incidental (pipe losses; irrigation return) processes. Recharge that is not extracted by pumping remains within the groundwater basin, which is eventually discharged to an outflow source such as a spring, lake, ocean or bay. The SFWD proposes to evaluate the City's groundwater basins for development potential, considering a variety of factors, including, but not limited to: basin yield/supply availability; water quality; cost of producing water; proximity to sensitive water resources (e.g., Lake Merced); technical feasibility; and location relative to existing distribution network. Where feasible, the SFWD would propose to construct wells to extract groundwater.

Short-Term Activity 5A1: Extract Groundwater from Elk Glen Well; Add to Main Distribution System. The SFWD proposes to renovate and use an existing Elk Glen Well in Golden Gate Park or install a replacement well if necessary for groundwater extraction. The extracted groundwater would be chlorinated, and then added to the City's main distribution system. This proposed project is described in greater detail, below, under Types of Actions and Projects, at pp. 90-96, Specific Proposed Projects, at pp. 97-102 and GWMP Implementation, at pp. 103-108.

Short-Term Activity 5A2: Extract Groundwater from the Sunset District; Add to Main Distribution System. The SFWD proposes to construct two new wells in the Sunset

District, in the vicinity of 44th Avenue between Kirkham and Quintara Streets. Groundwater would be extracted from these wells, chlorinated, and then added to the City's main distribution system. The final selection of locations would await the results of some of the other Short-Term Activities described above, in particular, Activity 1A1, regarding evaluation of potential for saltwater intrusion. This proposed project is described in greater detail, below, under Types of Actions and Projects, at pp. 90-96, Specific Proposed Projects, at pp. 97-102 and GWMP Implementation, at pp. 103-108.

Long-Term Strategy 5B: Capture Groundwater Produced by Dewatering Operations. Groundwater levels within many parts of the Downtown Basin are high. In some locations (e.g., BART stations and building basements) pumping is required to keep subsurface facilities dry. In most cases, groundwater currently pumped from these locations is discharged to the sewer system. The SFWD proposes to capture and use this groundwater, where feasible.

Short-Term Activity 5B1: Add Groundwater to the AWSS from Dewatering at the Powell Street BART Station. The SFWD proposes to capture groundwater that is currently being pumped from the Powell Street BART Station, and divert that water into the Auxiliary Water Supply System (AWSS), which is maintained by the Fire Department for fire fighting purposes. This proposed project is described in greater detail below under Types of Actions and Projects, pp. 90-96, Specific Proposed Projects, pp. 97-102, and GWMP Implementation, pp. 103-108.

Short-Term Activity 5B2: Identify Permanent Dewatering Operations in the City and Identify Potential Beneficial Uses of the Water. The SFWD proposes to identify other dewatering sites within the City, and evaluate those sites for possible dewatering reuse projects (based on water quality, cost, technical feasibility, etc.).

Short-Term Activity 5B3: Develop Procedures to Put Temporary Construction Dewatering Water to Beneficial Use. Temporary dewatering is common during construction projects with deep excavations. The SFWD proposes to develop procedures which would be incorporated into the City's permit review and approval process that would require evaluation of the potential for beneficial use of groundwater from temporary dewatering operations.

Short-Term Activity 5B4: Evaluate the Feasibility of Using, and Implement if Appropriate, the Existing Sludge Line to Convey Non-Potable Water to the North Point Plant. The City's North Point Wastewater Treatment Plant could use non-potable water for some of its cleaning and maintenance activities. The SFWD proposes to evaluate the feasibility of delivering dewatering water to that facility, for non-potable uses, through a former sludge transport pipeline.

Long-Term Strategy 5C: Operate Groundwater Basins Conjunctively. Conjunctive use of water resources is the planned and coordinated use of groundwater and surface water supplies. In San Francisco, one example of conjunctive use would be the use of groundwater basins as storage reservoirs, directly injecting surface water into the groundwater basins during wet years, when

surface water is available, and using groundwater as a potable water supply during dry years. A second example is in-lieu recharge, supplying surface water in wet years to groundwater users, so that groundwater that would otherwise be used is left in the ground. The groundwater left in the ground would then be available for extraction during dry years. The SFWD proposes to evaluate and implement conjunctive use of the City's water resources.

Short-Term Activity 5C1: Conduct In-Lieu Recharge of the Southern Portion of the Westside Basin. The SFWD is discussing with the cities of Daly City and San Bruno, and with the California Water Service Company, the potential for an in-lieu recharge program for the southern portion of the Westside Basin. One option under consideration is for the SFWD to supply surface water when available to users who are currently pumping groundwater, in exchange for a reduction in groundwater pumping, in order to allow the groundwater basin to recharge. Those users would then pump additional groundwater when surface water was in short supply.

Short-Term Activity 5C2: Conduct Conjunctive Use in the Lobos Basin. The SFWD proposes to evaluate the Lobos Basin to determine the most appropriate approach to conjunctive use within the basin. In-lieu recharge, or direct recharge of groundwater basins with surface water supplies are approaches that will be evaluated.

Long-Term Strategy 5D: Investigate Other Groundwater Basins. Groundwater resources in the Marina, South, Islais Valley and Visitacion Valley basins are generally undeveloped, and data on the hydrogeologic properties and water quality of those basins are limited. The SFWD proposes a long-term strategy of further investigation of those basins, as well as further investigation of the Lobos Basin to evaluate groundwater development potential.

Short-Term Activity 5D1: Develop and Implement a Study of the Lobos Basin. Groundwater in the Lobos Basin underlying the Richmond District and a portion of the Presidio is pumped and used by the National Park Service to meet water demand at the Presidio. The SFWD proposes to conduct a study of this basin to determine its groundwater development potential. The studies would generally assess recharge and extraction rates, the relationship of the creek to the basin, and the effects of Presidio groundwater use on groundwater levels and quality.

Short-Term Activity 5D2: Develop and Implement Studies of Other Shared and City Basins. The SFWD proposes to conduct further studies in the Marina, South, Islais Valley and Visitacion Valley Basins, in order to evaluate their groundwater development potential. Although these studies are shown in the GWMP as short-term activities, they are not expected to occur within the first five-year GWMP implementation phase.

Long-Term Strategy 5E: Evaluate Other Potential Activities for Increasing Groundwater Use. The SFWD intends to continue to evaluate all potential activities for increasing groundwater use.

Short-term Activity 5E1: Evaluate, and Implement Where Feasible, Potential Groundwater Use in the City's Fountains and Decorative Pools. The SFWD proposes to evaluate the potential use of groundwater at fountains and decorative pools on both public and private property within the City.

Short-term Activity 5E2: Evaluate, and Implement Where Feasible, the Potential for Groundwater to Help Control Corrosion in the City's Water Distribution System. Currently, the City's water distribution system contains localized areas with corrosion potential that could cause pipe corrosion, and, eventually, pipe leaks. The SFWD proposes to evaluate the potential for blending groundwater with system water to address this existing problem.

GROUNDWATER USERS

The GWMP identifies four groups of potential groundwater users within the City: individual non-potable users, individual potable users, local distribution system potable users, and main distribution system potable users. The individual non-potable user group is the only one of the four user groups with a demand for non-potable water, which overlaps with identified recycled water users; priorities for supplying non-potable water to these users are discussed below. The other three groundwater user groups are customers with a demand for potable water, which could be met with any one of three distribution mechanisms discussed below. As individual groundwater projects are identified, users and means of distribution to users would be determined according to the location and scale of the project.

Individual Non-Potable Users

Non-potable uses of groundwater include irrigation of large landscaped areas (such as parks, golf courses, and athletic fields), toilet flushing and cooling in commercial areas, fire fighting, and decorative fountains. The individual non-potable user group is the same group of users identified in the Recycled Water Master Plan as potential recycled water users. See Recycled Water Master Plan Project Description, p. 29, above for a discussion of potential recycled water users. The Water Department and the Department of Public Works are planning for the coordinated use of groundwater and recycled water throughout the City. In the future, water from three sources may be available for non-potable users: recycled water, groundwater and surface water. The two departments have established the following general priorities for supplying non-potable water to this group of users: first, recycled water; second, groundwater (where recycled water is unavailable or inappropriate); and finally, surface water (where both recycled water and groundwater are unavailable or inappropriate). However, the actual source of

a user's non-potable supply would depend on a number of factors, including economics, location, and water quality requirements.

Currently, groundwater is being used to some extent to supply non-potable irrigation users in Golden Gate Park, the Zoo, and golf courses near Lake Merced. These users are targeted to receive recycled water under the RWMP by the year 2000, and until Phase 1 of the RWMP is completed, these non-potable users would continue to use groundwater. In the long-term, the main anticipated uses of non-potable groundwater would include toilet flushing and cooling systems in large office buildings located in the Downtown Basin and supplementary supply water for the AWSS.

Individual Potable Users

For purposes of the GWMP, individual potable users would be those for whom the SFWD could extract, treat, and deliver groundwater directly as potable water. Individual potable users would be those with a substantial localized demand for potable water in proximity to a groundwater well with appropriate water quality and adequate yield for such uses. Examples of such potential users could include schools and large retail or commercial complexes (e.g., commercial laundries) in the Westside Basin. No individual potable groundwater use projects are currently proposed under the GWMP.

Local Distribution System Users

Local distribution system users are connected to the City's potable water supply pipelines measuring 12 inches in diameter and less. For these users, the SFWD could extract, treat, and inject groundwater into the local distribution system. The local distribution system would be used to blend the groundwater with the surface water already in the system; this blended water would be distributed to the user. This distribution mechanism would supply water to all potable water users within the range of the local distribution system. Local distribution users are generally single family homes. No local distribution system users are currently proposed under the GWMP.

Main Distribution System Users

The City's water supply main distribution pipelines are 16 inches in diameter or greater and are used to transport water around the City. No customers are connected directly to the City's water

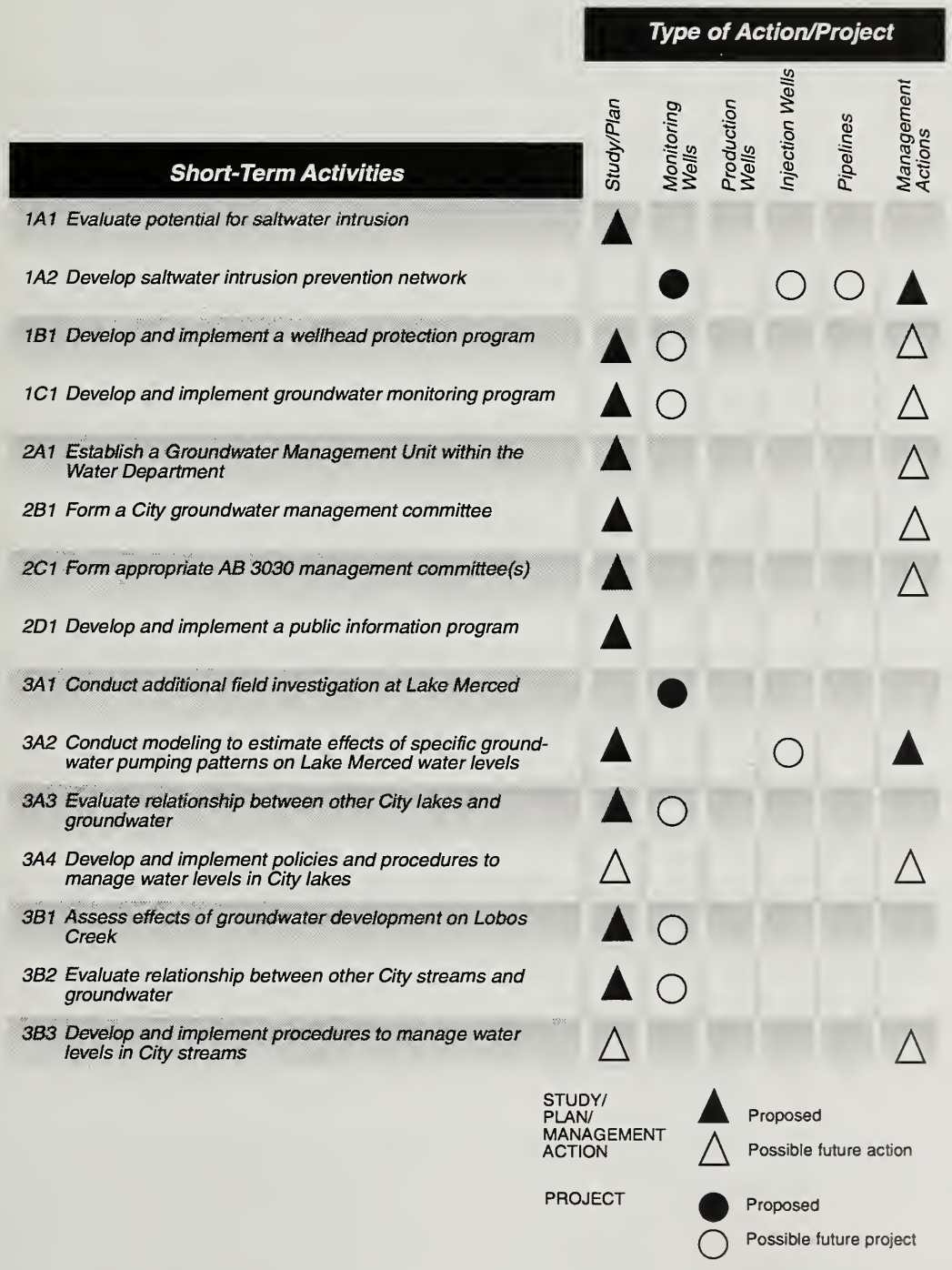
mains but some are supplied water from the main distribution system by feeder lines measuring 6 to 8 inches in diameter. The SFWD could extract, and either treat or blend groundwater (if it does not meet drinking water standards) with surface water before injecting the blended water into the main distribution system, or the SFWD could inject groundwater directly into the main distribution system (if it meets drinking water standards) where the two water sources would be blended. This distribution mechanism would supply potable water to users throughout the City. Short-Term Activities 5A1 and 5A2 currently proposed under the GWMP would provide groundwater for main distribution system users.

TYPES OF ACTIONS AND PROJECTS

As discussed above, the GWMP consists of goals, long-term strategies and short-term activities. This section provides a brief description of the general types of actions and projects to be executed under Short-Term Activities, as well as over the long-term implementation of the GWMP. This overview of types of actions and projects allows for the initial assessment of potential environmental impact associated with these types of actions and projects in this Program EIR. As the short-term activities in the first phase of implementation are completed, follow-on activities would be identified for implementation as progress continues towards achieving the GWMP goals. This Program EIR provides a foundation for more detailed environmental impact analysis as future specific actions and projects are proposed.

The Short-Term Activities identified in the GWMP represent a variety of specific actions and facility projects that would be undertaken. These activities can generally be categorized as: a) study or planning efforts, b) well facilities, c) distribution facilities, and d) water supply management/operational actions. Figures 27 and 28 classify the proposed Short-Term Activities by these general categories. As shown by these tables, many of the Short-Term Activities involve study or planning efforts. These study or planning efforts would likely lead to specific facility projects and/or management actions. For each short-term activity proposed, Figures 27 and 28 indicate whether a specific study, facility project and/or management action is proposed now, and also if subsequent study, facility projects and/or management actions are possible and may be recommended once the first short-term activity is completed. The types of actions and projects are described below.

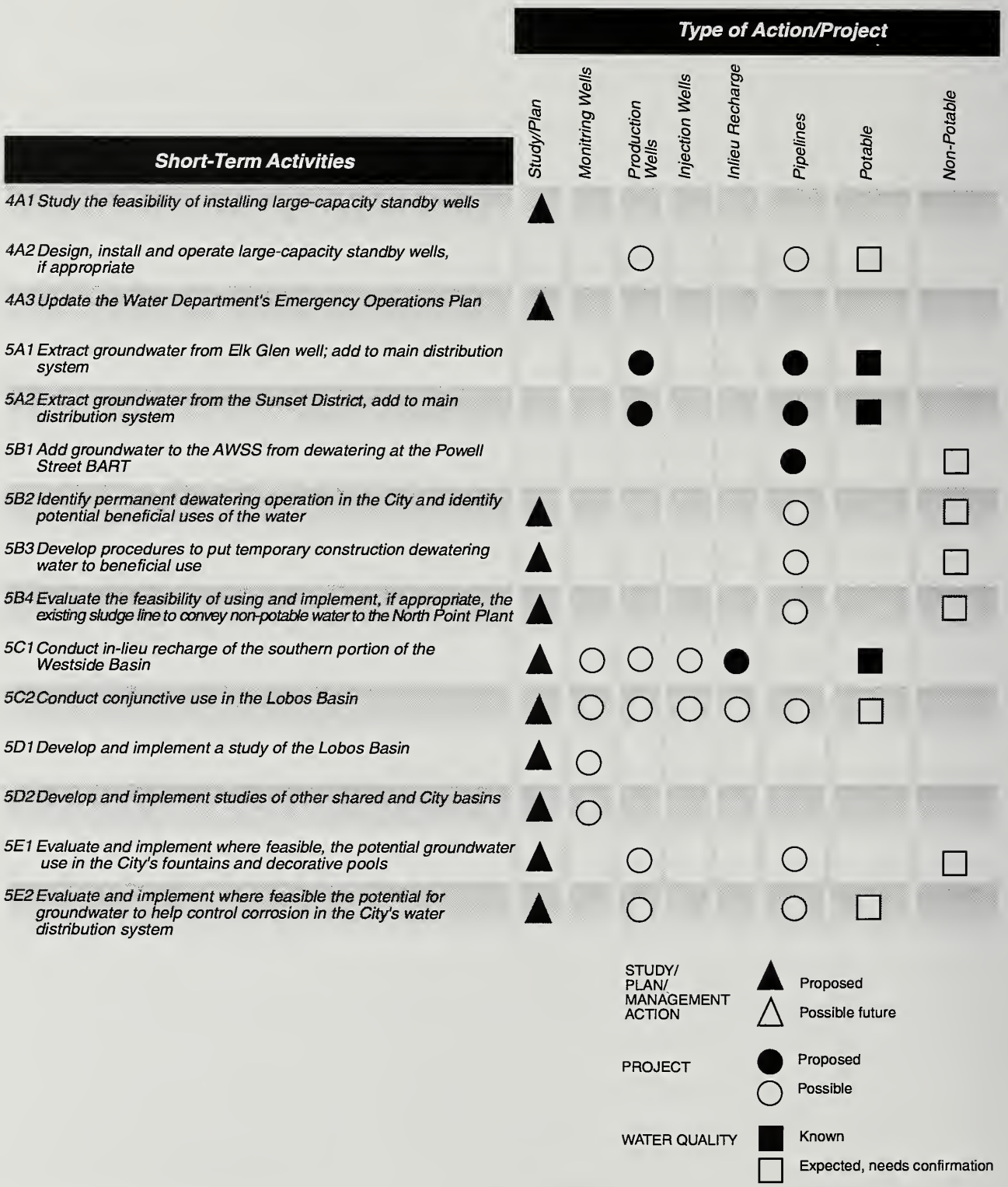
Specific near-term projects proposed in the GWMP are evaluated at a project level of detail with evaluation of site specific construction and operation impacts. Potential future projects that


Type of Action/Project
Short-Term Activities
Study/Plan
Monitoring Wells
Production Wells
Injection Wells
Pipelines
Management Actions
1A1 Evaluate potential for saltwater intrusion
1A2 Develop saltwater intrusion prevention network
1B1 Develop and implement a wellhead protection program
1C1 Develop and implement groundwater monitoring program
2A1 Establish a Groundwater Management Unit within the Water Department
2B1 Form a City groundwater management committee
2C1 Form appropriate AB 3030 management committee(s)
2D1 Develop and implement a public information program
3A1 Conduct additional field investigation at Lake Merced
3A2 Conduct modeling to estimate effects of specific groundwater pumping patterns on Lake Merced water levels
3A3 Evaluate relationship between other City lakes and groundwater
3A4 Develop and implement policies and procedures to manage water levels in City lakes
3B1 Assess effects of groundwater development on Lobos Creek
3B2 Evaluate relationship between other City streams and groundwater
3B3 Develop and implement procedures to manage water levels in City streams
STUDY/ PLAN/ MANAGEMENT ACTION
Proposed
Possible future action
PROJECT
Proposed
Possible future project

SOURCE: Environmental Science Associates, 1995

SF RWMP/GWMP Program EIR ■

Figure 27
Type of Actions/Projects Associated with Groundwater Management Short-Term Activities


Type of Action/Project
Short-Term Activities
Study/Plan
Monitring Wells
Production Wells
Injection Wells
Inlieu Recharge
Pipelines
Potable
Non-Potable
4A1 Study the feasibility of installing large-capacity standby wells
4A2 Design, install and operate large-capacity standby wells, if appropriate
4A3 Update the Water Department's Emergency Operations Plan
5A1 Extract groundwater from Elk Glen well; add to main distribution system
5A2 Extract groundwater from the Sunset District, add to main distribution system
5B1 Add groundwater to the AWSS from dewatering at the Powell Street BART
5B2 Identify permanent dewatering operation in the City and identify potential beneficial uses of the water
5B3 Develop procedures to put temporary construction dewatering water to beneficial use
5B4 Evaluate the feasibility of using and implement, if appropriate, the existing sludge line to convey non-potable water to the North Point Plant
5C1 Conduct in-lieu recharge of the southern portion of the Westside Basin
5C2 Conduct conjunctive use in the Lobos Basin
5D1 Develop and implement a study of the Lobos Basin
5D2 Develop and implement studies of other shared and City basins
5E1 Evaluate and implement where feasible, the potential groundwater use in the City's fountains and decorative pools
5E2 Evaluate and implement where feasible the potential for groundwater to help control corrosion in the City's water distribution system
STUDY/ PLAN/ MANAGEMENT ACTION
Proposed
Possible future
PROJECT
Proposed
Possible
WATER QUALITY
Known
Expected, needs confirmation

SOURCE: Environmental Science Associates, 1995

SF RWMP/GWMP Program EIR ■

Figure 28
Type of Actions/Projects Associated with Groundwater Development and Use Short-Term Activities

could be recommended at the conclusion of a proposed planning or study effort (such as a new monitoring well or supply well) are evaluated at a program-level, with more general analysis of the potential types of impacts that could result. This analysis is not site specific and additional CEQA review could be required in the future once a specific project is developed.

Study or Planning Effort

Many of the proposed Short-Term Activities would involve conducting a study/investigation for data collection purposes or coordinating and executing a planning effort such as an interagency committee. Implementing these study and planning efforts themselves would not have physical environmental impacts; however, specific facility projects and water management actions may result (and are intended to result) from these efforts and these may have physical environmental effects.

Well Facilities

Implementation of planned and possible activities under the GWMP could involve construction of well facilities for the following purposes: monitoring/observation, extraction/production, and recharge/injection. Each of these well types is described below; well construction is described on p. 105.

Monitoring, or observation wells are used for observing groundwater levels and flow conditions, obtaining samples for determining groundwater quality, and for evaluating hydraulic properties of the groundwater system at that location. They are generally a smaller diameter well than a production well (less than 10 inches and can be less than 2 inches in diameter). The top of the well, or wellhead, is protected by a locking cover to restrict access, and could be terminated above or below ground surface. Monitoring wells require limited, if any associated facilities; monitoring wells would not require treatment facilities, but some could include sampling pumps in small housing structures on-site.

Production or extraction wells are used to pump large volumes of groundwater from the underground basin to the surface. Injection wells are used to pump fluids into the surrounding aquifer. For some injection wells, water of suitable quality is injected into an aquifer to supplement natural recharge. Both production wells and injection wells would affect the subsurface conditions and overall groundwater recharge/discharge system as well as localized

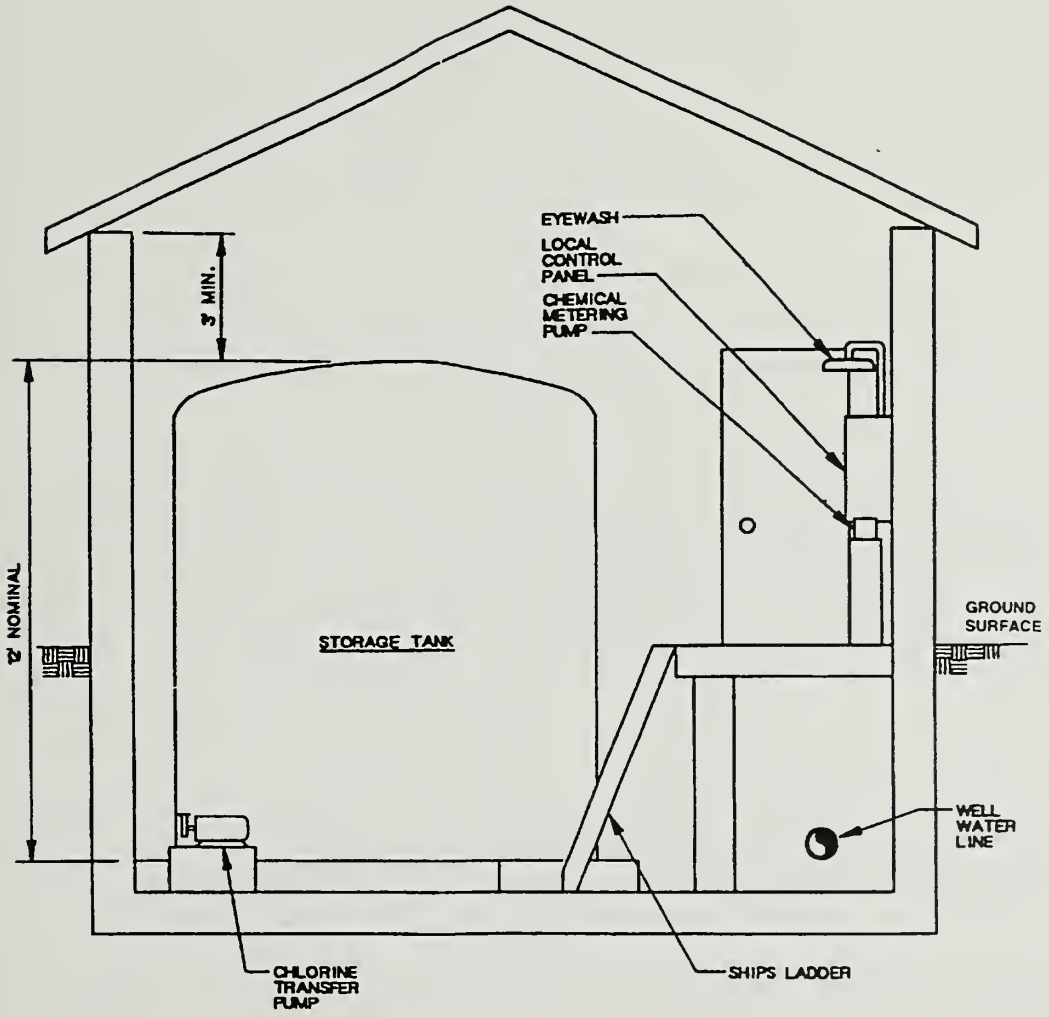
above-ground conditions associated with facility construction and operation. Both production and injection wells require a connection to external piping, production wells would add water to a water supply line, and injection wells would require a water supply source.

A production/extraction well could serve as an injection well, or vice versa, depending on the design and purpose of the well, and can also be used for monitoring purposes. These type of wells are generally larger in diameter than a monitoring well and require more space, facilities and housing. A production or injection well would have pump facilities, power generation facilities, meters, piping, and other plumbing systems. The number, type, and size of pumps to operate production and injection wells would depend on the proposed well capacity, groundwater basin characteristics, and frequency of operation. For injection wells, a source of fluids for injection (such as surface water or recycled water) would be required along with the pumping and distribution facilities needed to convey the injection fluid to the site of the injection well. No injection wells are currently proposed under the GWMP short-term activities, but they are being evaluated as possible means of achieving long-term strategies.

For the near-term production wells proposed in the GWMP under Short-Term Activities 5A1 and 5A2, it is estimated that each well site would require one vertical turbine pump with a maximum design capacity of 1,000 gpm, assuming a well depth of about 300 feet. An adjustable frequency drive would vary the pump speed and flow rate. Figure 29 depicts the layout of a typical extraction and chlorination station.

For the proposed potable uses of groundwater, there would also be a chlorination station at the water well site that would be used to disinfect the groundwater prior to blending with the main water supply system. The proposed disinfection would use 14% sodium hypochlorite stored in 6,500-gallon polyethylene storage tanks on each site. There would be transfer pumps to transfer the sodium hypochlorite solution from the storage tank to a 150-gallon polyethyllene day tank, and a chemical metering pump to draw from the day tank to provide the necessary dosage of disinfectant to the groundwater. A magnetic-type flow meter would be installed in the well water line for monitoring the station water output. Figure 29 also shows the layout and elevation of a typical chlorination station.

The chlorination station would contain a combination safety shower and eyewash. The station would also include an automatic submersible sump pump and a hose bib with a 3/4-inch hose for



SOURCE: CH2MHill, *Groundwater Master Plan*, Technical Memorandum 12b, Draft, March 1995

SF RWMP / GWMP Program EIR ■

Figure 29
Typical Extraction and Chlorination Station for Water Supply Well

wash-down use. A roof exhaust fan and wall louvers would provide ventilation of approximately 4 to 5 air-changes per hour.

The pump and chlorination stations would require a 200-gallon-per-minute (gpm) intermittent potable water supply for the safety shower/eyewash and hose bibs. Each station would also require a 480-volt electrical connection for the well pump and other equipment. The 480-volt source would be reduced in the electrical area for the stations' 240/120 volt requirements.

Figure 29 shows a typical production well and chlorination station facility. All facilities are enclosed within a structure that measures about 640 square feet; in this example the structure is 20 feet wide by 32 feet long. The facility sits partially below ground, extending about 6 feet below grade and about 15 feet above grade.

Well construction proposed under the GWMP could involve a combination of rehabilitation of existing wells and construction of new wells. Existing wells would be used to the extent possible. Where necessary and cost effective, existing wells would be upgraded to meet current well standards.

Pipelines / Distribution Facilities

As described above, under "Groundwater Users," p. 88, groundwater would be distributed to water customers through the City's existing main water distribution system.

Under any distribution scenario, specific facility projects would generally involve construction of small diameter (e.g., 12 inches or less) buried pipelines extending short distances (e.g., less than a mile) to deliver groundwater to the system or user.

Management/System Operation Actions

This category refers to possible actions the SFWD could take to manage the storage and delivery of water in response to changing supply and demand scenarios. This is generally the concept of conjunctive use, in which water demand is met through coordinated management of surface and groundwater supplies. Possible conjunctive use strategies are outlined above under the discussion of Long-Term Strategy 5C (p. 86). These types of activities could involve use of injection wells to augment recharge of groundwater basins during wet years or could involve management actions only. Physical implications of injection wells would be the same as those

discussed above under Well Facilities (p. 93). Similar to studies or planning efforts, management actions alone would not have physical environmental impacts, but there could be physical implications of re-directing water supplies.

SPECIFIC PROPOSED PROJECTS

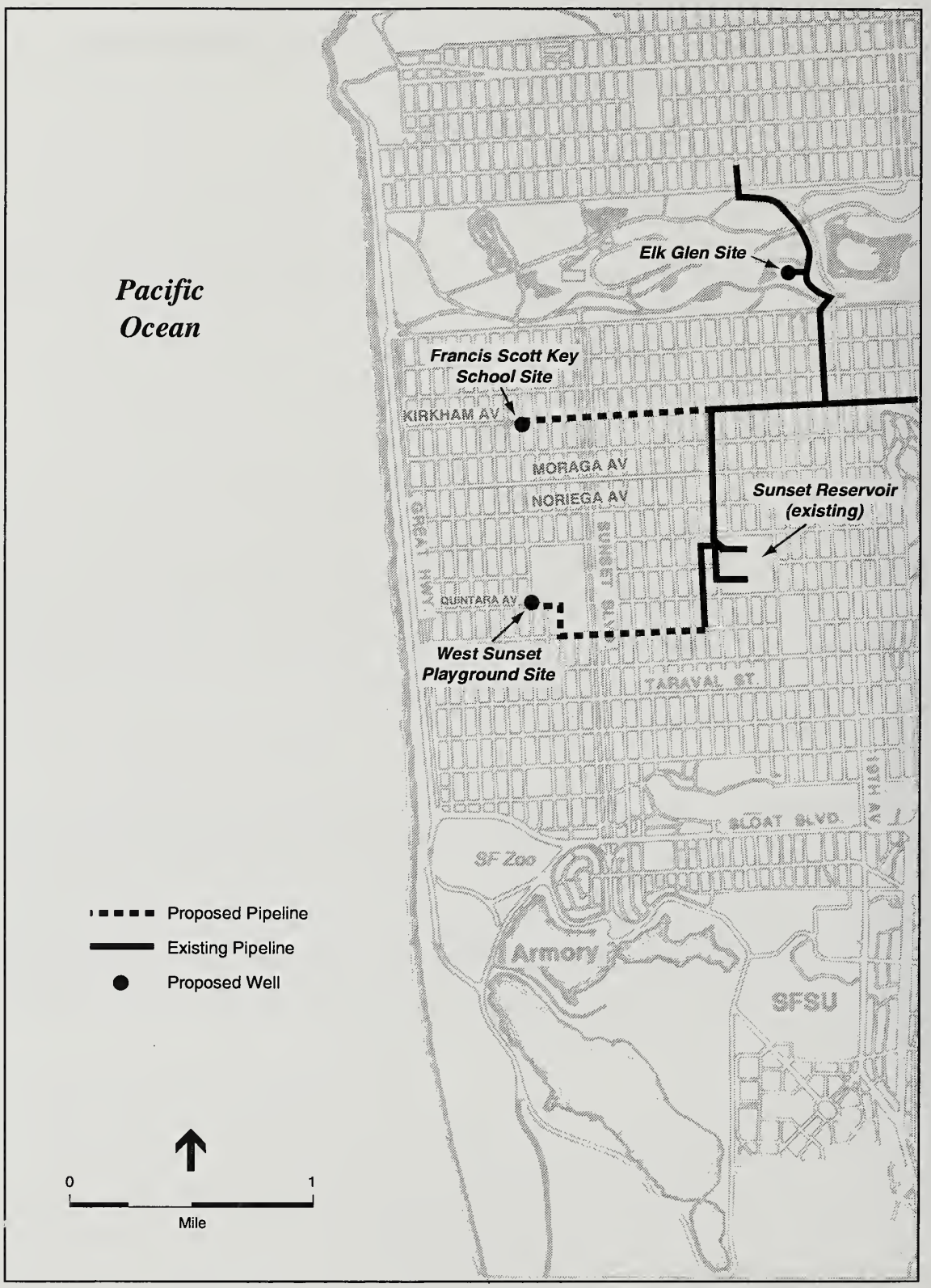
The GWMP proposes the following specific projects to be completed within five years of plan adoption. These projects are included in the GWMP under Short-Term Activities 5A1, 5A2, 5B1 and 5C1.

Elk Glen Well

Elk Glen Well is an existing well located on the northeast side of Elk Glen Lake in Golden Gate Park, near the intersection of Middle Drive West and Transverse Drive (see Figures 30 and 31). The well is approximately 380 feet deep with the groundwater surface at about 60 to 70 feet below grade, and is currently used for irrigation at Golden Gate Park. Groundwater from the Elk Glen Well is of potable quality. The well pumps groundwater from 170 to 350 feet below grade, and it currently has an estimated continuous pumping capacity of 1,300 ac-ft/yr. It is currently pumping about 500 ac-ft/yr.

Under Short-Term Activity 5A1, the Elk Glen Well would first be evaluated to determine whether or not the well meets construction standards for public drinking water supply wells. If the well does not meet the standards, the SFWD would determine if the well can be modified or if it has to be replaced. If it has to be replaced, SFWD would coordinate with Recreation and Park Department to determine whether the replacement well could be installed in the immediate vicinity of the existing well (this would prevent having to conduct water quality and aquifer testing in a new area) or if there is another suitable location.

Rehabilitation of the Elk Glen Well would include the installation of a chlorination station, flow meter and 3-way valve in the approximate location of the existing chain-link enclosure surrounding the well. As shown on Figure 31, an approximate location for this chlorination station has been identified on either side of an existing trail. If the existing well site is used, SFWD would work with the Recreation and Park Department to site the chlorination station nearby in a manner that minimizes impact to park use. Modification of the existing well seal and cleaning and/or repair of the existing pump would also be considered during well rehabilitation. The flow meter, which would be attached to the above-ground piping of the well, would be used



SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

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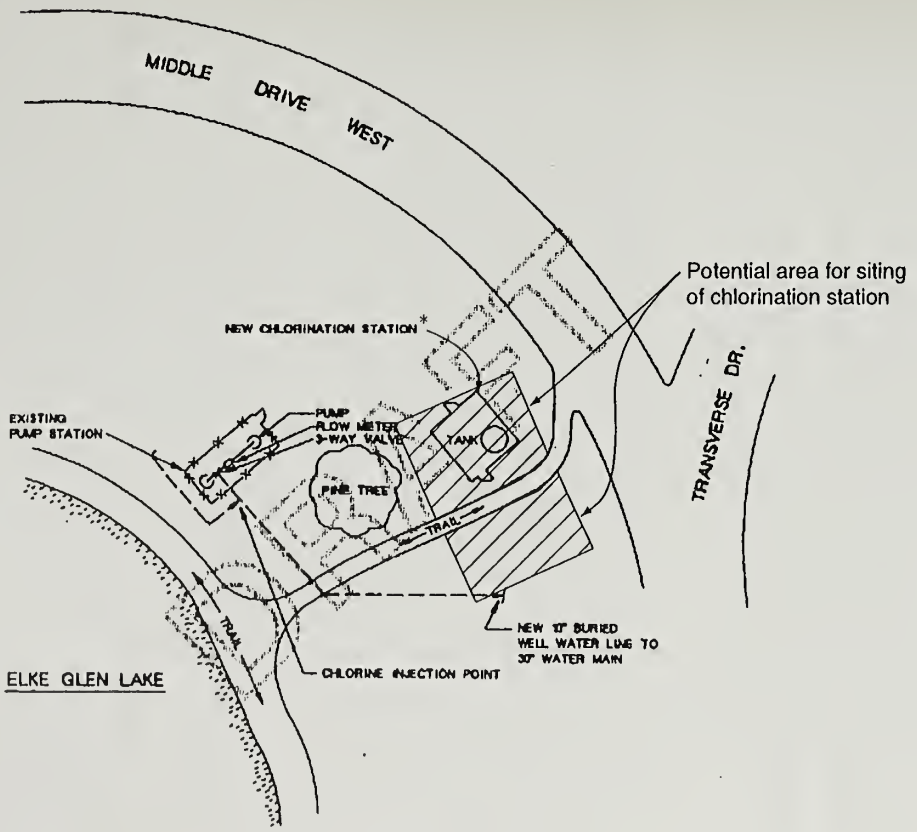
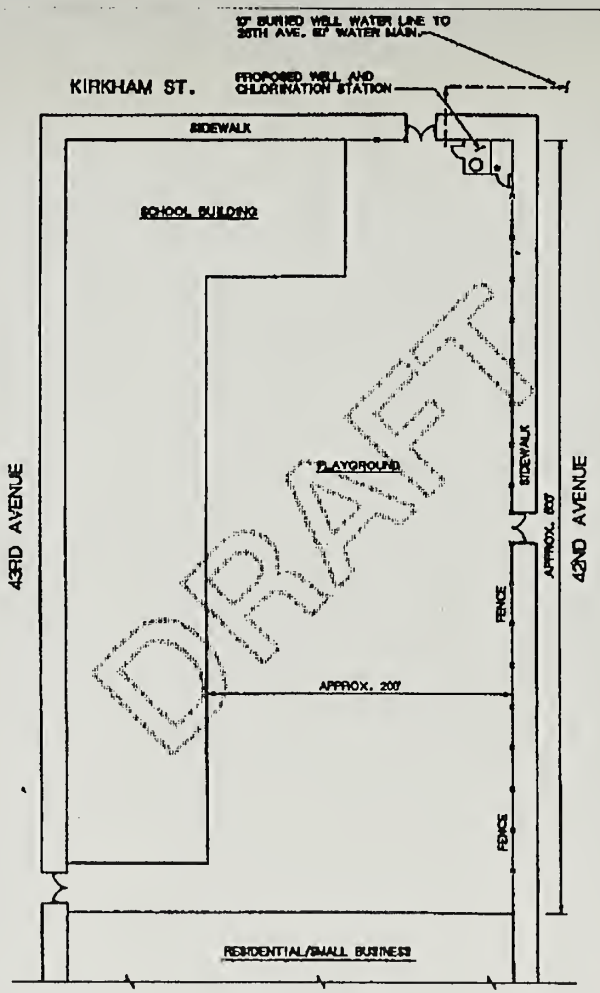
Figure 30
Location of Westside Wells



PLAN

Elk Glen Lake
Location of Proposed Chlorination Station at Existing Well Site

* Approximate location of chlorination station if existing well is selected for use.
Actual location to be determined in consultation with the SF Recreation and Park Department.



PLAN

Francis Scott Key School
Proposed Well and Chlornation Station

SOURCE: CH2MHill, *Groundwater Master Plan*, Technical Memorandum 12a, Draft, March 1995

Figure 31
Elk Glen Well and Francis Scott Key School Well Layouts

for monitoring the groundwater extraction flow rate of the well. The 3-way valve, which would also be attached to the above-ground piping, would be used to divert the groundwater to either the park irrigation system or to the City's water main as appropriate. Chlorine solution from the proposed chlorination system would be injected into a 10-inch water line downstream of the 3-way valve (Figure 29, p. 95, shows a typical well and chlorination station. The 10-inch water line would be routed east, below grade, along paved and soft surface park roads and paths to the existing 30-inch water main located about 120 feet away at Traverse Drive. With rehabilitation as described above, the Elk Glen Well would be designed with a continuous pumping capacity of approximately 1,000 to 1,600 ac-ft/yr. However, actual pumping rates would be determined by groundwater modeling efforts, and would be lower than design capacity in order to prevent saltwater intrusion. Preliminary modeling results indicate that the maximum pumping rate would be about 850 ac-ft/yr.

If the Elk Glen Well is replaced onsite, a new well would be drilled to approximately the same depth as the existing well and would be expected to have the same pumping capacity as projected for the rehabilitated well. The onsite replacement well would require a chlorination station, 3-way valve, flow meter, and distribution water line, all as described above for rehabilitation. A new replacement site alternative for this well has not been identified at this time; a new well site option is not covered at a project level in this document.

Sunset District Wells

Under Short-Term Activity 5A2, new municipal water wells would be installed at the following locations in the Sunset District: Francis Scott Key School and the West Sunset Playground (see Figure 30). The decision regarding the location and pumping rate of the Sunset District wells would be based on aquifer testing and water quality testing at test wells at each of the proposed sites and on computer modeling of saltwater intrusion. See Section 5.B.2, Groundwater Master Plan, Groundwater and Surface Water Resources, p. 385, for a more detailed description of the approach to well and pumping evaluation.

The design capacity of each well would be approximately 1,000 ac-ft/year. However, actual pumping rates would be determined by groundwater modeling efforts, and would be lower than design capacity in order to prevent saltwater intrusion. Preliminary modeling results indicate that the maximum pumping rate for each well would be up to 300 to 400 ac-ft/yr of potable water, depending on the number of wells, for a total of about 900 ac-ft/yr. Groundwater extracted from these wells would be injected to the City's existing main water distribution

system. New facilities at each site would consist of a combination pumping and chlorination station (see Figure 29, p. 95, for a typical well and chlorination station).

Francis Scott Key School

Francis Scott Key School is bounded by 42nd and 43rd avenues and Kirkham and Lawton streets (see Figure 31, p. 99). The proposed well and chlorination station would be located in the northeast corner of the playground. The playground is approximately 800 feet by 200 feet and completely fenced. The playground is accessible from 42nd and 43rd avenues and Kirkham Street. A 10-inch pipeline would be installed below grade from the chlorination station east down Kirkham Street, connecting to the existing 60-inch water main on 28th Avenue.

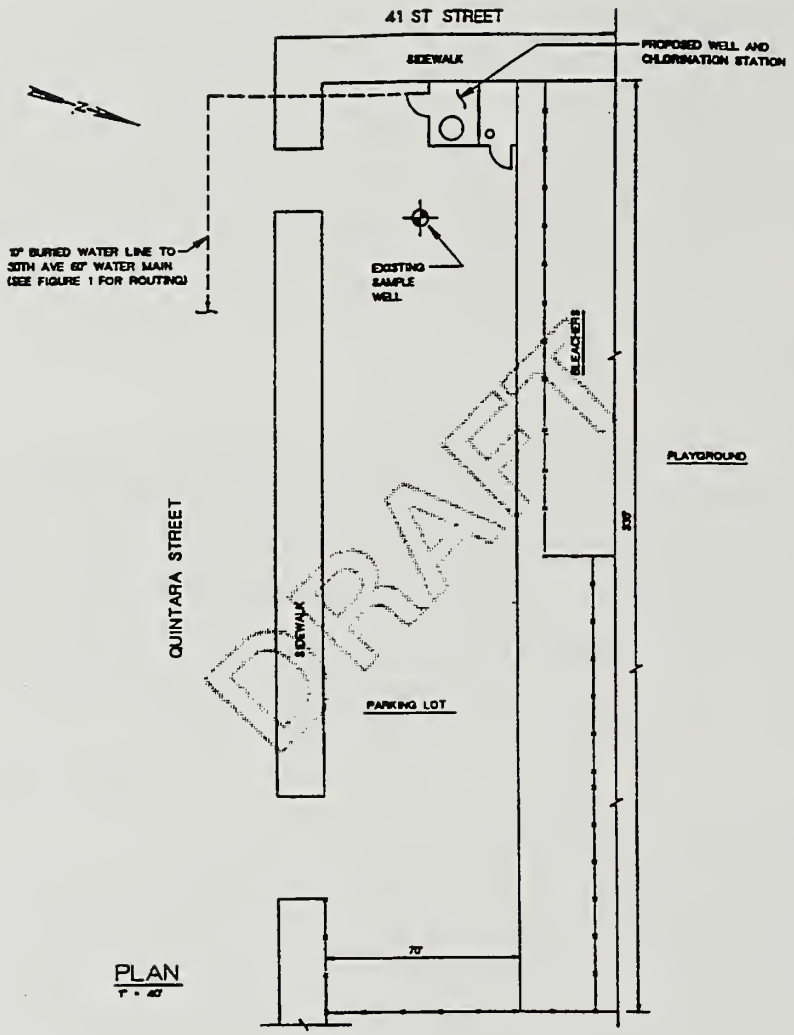
West Sunset Playground

West Sunset Playground is located at 41st Avenue and Quintara Street (see Figure 32, p. 102). The proposed well and chlorination station would be located in the northwest corner of the existing parking area, which is approximately 335 feet by 70 feet. The site is accessible from Quintara Street. A 10-inch pipeline would be installed below grade from the chlorination station east up Quintara Street, south along 39th Avenue, and east up Rivera Street connecting to the existing 60-inch water main on 30th Avenue. A test well was installed at this location in 1993 by the Water Department during development of the GWMP.

Powell BART Station Dewatering Reuse

There is an existing groundwater dewatering facility located at the south end of the lower level of the Powell Street BART Station. A sump approximately 7-foot square and 17-feet deep receives water from floor drains in the center of MUNI and BART tracks. Two submersible pumps, each rated at 500 gallons per minute (gpm), lift water from the sump to a 5-foot-diameter sewer that runs along Market Street. Groundwater seeps through an interface between a tunnel shell and a steel toe liner at a location less than 100 feet away from the pump station. A continuous flow of water can be observed from the lower station platform, originating on the far side of the west tunnel and flowing into the floor drain nearest the pump station.

Groundwater flow into BART's dewatering facility at the Powell Street Station has been reported as continuous for a number of years. According to BART personnel, the flow has not changed appreciably between dry and wet seasons, nor between dry and wet years. Groundwater inflow



West Sunset Playground
Proposed Well and Chlorination Station

SOURCE: CH2M Hill, *Groundwater Master Plan*, Technical Memorandum 12b, Draft, March 1995

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Figure 32
West Sunset Playground Well Layout

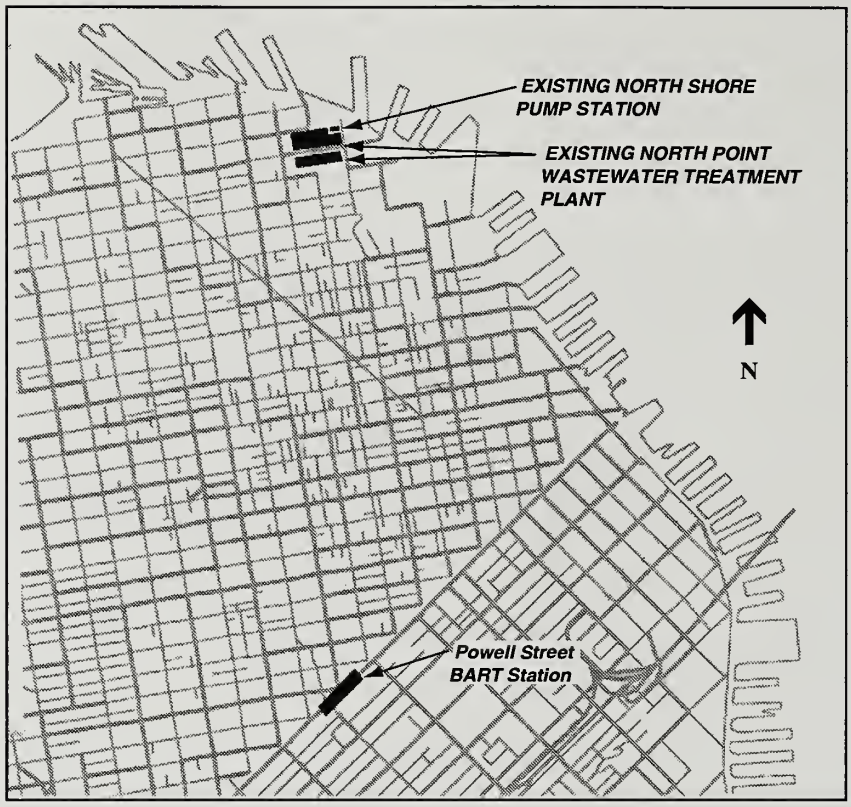
was measured by BART in December 1990, at 93 gpm. Assuming that the flow remains constant at the measured rate, there would be approximately 150 ac-ft/yr of water available from the dewatering facility.

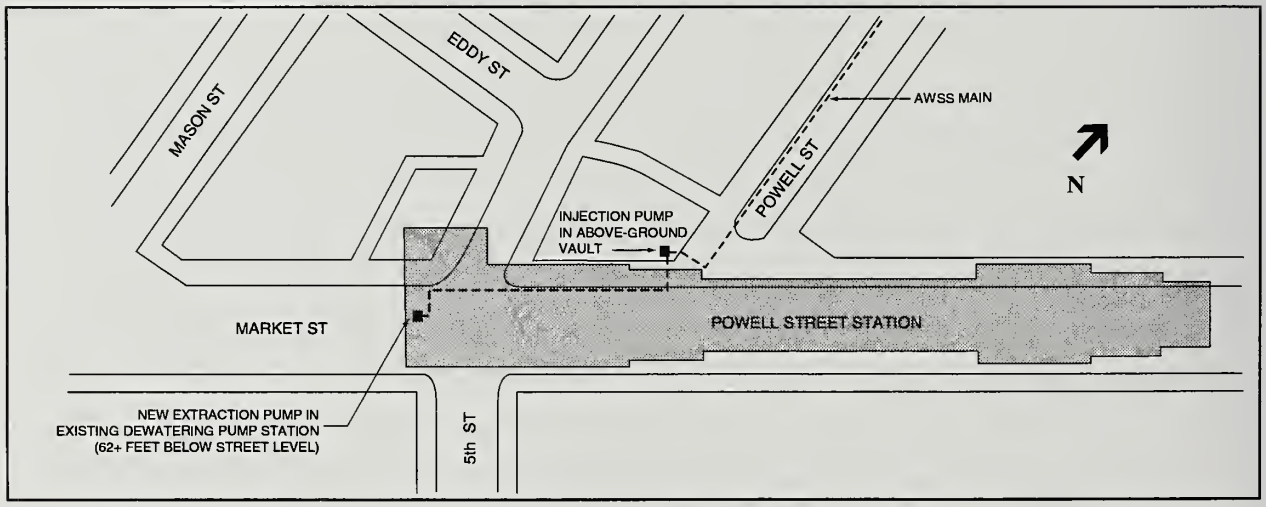
Under Short-Term Activity 5B1, the SFWD would extract groundwater that is being pumped from BART's dewatering facility and inject it into the AWSS to augment the fire fighting water supply. The proposed extraction and injection system, shown in Figure 33, would include the following components:

- A new submersible pump in the dewatering sump, capable of extracting 93 gpm at approximately 100 feet of head;
- Appropriate shutoff and check valves within the pump site enclosure;
- Discharge piping going up through the air vents adjacent to the pump station and eventually into a booster pump enclosure;
- A concrete vault enclosing a booster pump capable of injecting 93 gpm at over 500 feet of head, a water meter, and appropriate shutoff and check valves;
- Piping from the booster pump enclosure to the AWSS line along Powell Street.

In-Lieu Recharge of Southern Portion of Westside Basin

Under Short-Term Activity 5C1, the SFWD would provide surplus available imported surface water to groundwater users in the southern portions of the Westside Basin in exchange for the cessation or reduction of groundwater pumping. This would allow the groundwater basin to recharge. In future periods of drought when surface water supplies are below normal, the groundwater users would return to pumping groundwater to meet demand in-lieu of receiving surface water from the SFWD. The southern portion of the Westside Basin lies within San Mateo County. The City has initiated discussions with the cities of Daly City and San Bruno and the California Water Service Company to develop this type of conjunctive use program. As this program is developed, specific projects (such as installation of wells) may be recommended that would require a more detailed project-level environmental review than presented in this report.





SOURCE: CH2M Hill, *Groundwater Master Plan*, Technical Memorandum 12c, Draft, March 1995

SF RWMP / GWMP Program EIR ■

Figure 33
Powell Street BART Station
Dewatering Reuse Facilities Layout

GWMP IMPLEMENTATION - SCHEDULE, CONSTRUCTION SCENARIO AND COST

Schedule

Short-term activities identified in the GWMP are scheduled to be implemented or constructed over the next five years, assuming the financing program outlined in the GWMP is implemented (see Figures 25 and 26, pp. 76 and 77, for the schedule for individual activities). However, this schedule could change as additional activities are identified and various short-term activities are modified. The goals and long-term strategies in the GWMP would provide the conceptual framework for the City's groundwater management, development and use over the next 20 years.

Construction Scenario

The primary construction activity associated with the GWMP projects would be the construction of wells for monitoring and extracting groundwater, and of pipelines to distribute the water. The specific construction projects proposed in the GWMP are: the Sunset District wells, the Elk Glen Well and the BART dewatering re-use project. Other long-term and short-term activities proposed in the GWMP would most likely result in the construction of additional wells and pipelines. The construction scenario for each type of construction project likely to result from implementation of the GWMP is described below.

Production/Extraction Wells

Prior to installation of any production well, SFWD would go through a series of preliminary steps to determine the appropriate well location and well design. These steps would include drilling a test well if one does not yet exist in the vicinity of the proposed well sites, and using the test wells to conduct aquifer tests and water quality tests. This information would be used to estimate the potential groundwater production rate and quality at the site. Computer models would then be run to estimate the potential for saltwater intrusion, based on the proposed production rates. If the test well results and modeling indicate that conditions are appropriate, construction of the production well would begin.

The general approach for the construction of production/extraction wells is summarized below. This approach would be taken for construction of the production wells identified in the GWMP, the Sunset District wells and the Elk Glen Well, as well as for any production/extraction well projects to be identified in the future. Well construction could involve 24-hour activity.

Construction of the wells would involve the following stages:

- Obtain the necessary well permits (see discussion of project approvals below).
- Identify existing underground utilities for protection, or for relocation if the utility is to remain in service.
- Drill a test hole and evaluate aquifer properties, production potential, and water quality.
- Drill a 12- to 18-inch diameter pilot borehole to the depth of the proposed well. As the borehole is drilled, visually examine and record the nature of excavated material at regular intervals in order to ensure that the geohydrology of the site is appropriate for the well and that the well screen (the perforated section of the well piping through which groundwater is withdrawn) is installed in the proper interval. Ream (enlarge) the borehole to a diameter of about 30 inches. As material is removed from the borehole, it would be loaded onto an on-site temporary storage bin or onto a truck for off-site disposal. The borehole would be held in place with a circulation fluid. Fresh water from an approved source and approved commercial products would be used in drilling fluids.
- Install corrosion-resistant, copper-bearing steel well casing and well screen in 10- to 20-foot sections.
- Place sand pack around the well screen and seal the annular space above the sand pack with a sand/cement grout. The sand pack and grout are used to hold the well casing in place. The sand pack allows passage of groundwater to the screened interval of the well, while the grout prevents connection between the screened aquifer and any overlying aquifer through which the well was drilled, ensuring that groundwater is withdrawn only from the desired aquifer.
- Develop the well. Developing the well involves cleaning of the inside of the well casing with air-lift swabbing, and pumping water from the well to pull water through the sand pack, settling the sand pack and flushing out initial suspended solids.
- Conduct well production tests and aquifer tests. These tests allow estimation of groundwater properties (transmissivity and storage values) for the aquifer at the site.
- Construct foundation pad for pumps.
- Install pumps and equipment.

Construction of the chlorination station would begin once well construction was complete. Chlorination station construction would begin with excavation and shoring for construction of the foundation. Foundation construction would be followed by construction of the station building and installation of equipment, including storage tanks, pumps, piping and fans.

As listed in Table 11, about 1,800 to 2,000 square feet of area would be required for construction staging, and the final facility would be about 640 square feet. Construction of the Elk Glen Well would be staged adjacent to the site and beside Traverse Road. Construction of the Francis Scott

TABLE 11: CONSTRUCTION SCENARIO FOR TYPICAL PRODUCTION WELL

Construction Activity	**Typical Parameters**
Construction area	1,800 - 2,000 sq. ft.
Facility area (when complete)	640 sq. ft.
Construction duration	Eight weeks
Approximate well dimensions	
- Well depth	300 ft. - 500 ft.
- Diameter of well boring	30 in.
- Diameter of well	12-18 in.
Excavation	
- Chlorination facility excavation volume	166 cub. yds.
- Well excavation volume	65
Total excavation	231 cub. yds.
Pipeline excavation trench dimensions	2.5 ft. wide x 5 ft. deep
Crew Size	6
Construction traffic	
- Total truckloads	25
- Daily construction worker trips	15
Construction hours/times	Generally 7 am - 5 pm/weekdays but could involve 24-hr activity during drilling and aquifer testing.

SOURCE: Environmental Science Associates and CH2M HILL, 1995.

Key School well would most likely be staged on the school playground or on one of the adjacent streets. The West Sunset Playground well construction would most likely be staged on the remainder of the parking area.

Total excavation volume for construction of both the well and the chlorination station would be about 230 cubic yards. About 25 truck trips would be needed to deliver construction materials to the site and to haul excavated materials from the site. Construction would require a crew of about 6 people for a maximum of 8 weeks.

Monitoring Wells

The scale of the construction process (e.g. construction duration, amount of materials hauled to and from the site, area of disturbance, etc.) would be much smaller for monitoring wells than for production wells, because monitoring wells have a relatively small diameter (less than ten inches, and sometimes less than two inches) and because they require no permanent associated structures or facilities, such as housing structures or chlorination stations. Complete installation and development of monitoring wells would involve about one week and one truckload of excavated material to be hauled off-site.

Though at a smaller scale, construction of the monitoring well itself would involve much the same process as outlined in the bulleted list under Production Wells, above. Similar to production wells, the construction process for monitoring wells would include acquiring the required permits, checking for underground utilities, drilling the well, installing well piping, developing the well, and packing and sealing around the well. Aquifer tests may be conducted on the well. If the monitoring well is to be used for water quality monitoring, then the well water would be sampled for quality testing. A locking cap would be installed on the monitoring well within two feet of existing grade. No additional above-ground facilities would be constructed for operation of the monitoring well.

Powell Street BART Dewatering / Reuse

Construction of the Powell Street BART dewatering / reuse facility would take a maximum of one week. Installation of the new pump and valves in the dewatering sump would involve no excavation. Installation of discharge piping would involve drilling through concrete in an outside-station wall, as well as within a restricted-access area in the station (an area of the station not open to the public). Drilling would take less than one half-day.

The booster pump and enclosing concrete vault would most likely be installed adjacent to the Powell Street escalators. The vault enclosure would probably be pre-fabricated, rather than constructed on-site. Mainly hand-held equipment (such as jack-hammers and hand-held drills) would be used for construction of all the above facilities. No more than five workers would be needed. One truck trip would be needed to unload materials, and one truck trip would be need to off-haul any excavated materials and remove equipment. An approximately 15 foot by 15 foot staging area would be located on the lower / outdoor level of the station, for the duration of construction.

Connection of the dewatering facility to the AWSS would involve the construction of a 3- to 4-foot deep trench for a 2-inch pipe. Connection to the AWSS would be coordinated with the Fire Department and would take about one day.

Groundwater Distribution Pipelines

In addition to the wells and chlorination stations, construction of water distribution pipelines associated with the wells would occur. Proposed pipeline routes are listed above under the description of each well. The pipeline trench would average approximately 2.5 feet wide and 5 feet deep. Pipeline construction would occur at a rate of 50 to 100 feet per day. Construction of pipelines would be similar to the construction scenario described previously for transmission and distribution pipelines under the Recycled Water Master Plan Project Description (p. 29).

Estimated Project Cost

The total capital cost of funding the known short-term activities associated with the first five years of implementation of the GWMP is estimated to be about $8.6 million (based on 1995 dollars and does not include the effects of inflation). The estimated annual operation and maintenance costs to operate the activities at full implementation at the end of five years is about $977,000.

GWMP PROJECT APPROVALS

Following certification of the EIR in accordance with the *California Environmental Quality Act* and the *San Francisco Administrative Code*, approval of the GWMP and issuance of permits would be required by various local and regional agencies to allow implementation of the short-term activities included in the GWMP. Table 12 lists the various agencies and their authority over the GWMP and at each of the proposed facility sites.

TABLE 12: GROUNDWATER MASTER PLAN PROJECT APPROVALS

Agency	Authority	GWMP	Elk Glen Well	Sunset Wells	Powell BART	In-Lieu Recharge	Monitoring Wells
Local							
San Francisco Board of Supervisors	Adoption of the Groundwater Master Plan.	X	X	X	X	X	
	Approval of new structures in Golden Gate Park (2/3 majority).		X				
San Francisco Public Utilities Commission	Groundwater Master Plan Adoption and Project Approval.	X	X	X	X	X	X
San Francisco City Planning Commission	Determination of project conformance with objectives and policies of the *San Francisco General Plan.*	X	X	X	X	X	
San Francisco Art Commission	Approval of exterior design of proposed facilities in accordance with Section 3.13 of the *San Francisco Administrative Code.*		X	X			
San Francisco Fire Commission	Approval to use the Auxiliary Water Supply System (AWSS) for joint use of system with groundwater distribution				X		
San Francisco Bureau of Light, Heating and Power	Approval to connect proposed facilities to PG&E's power grid.		X	X	X		
San Francisco Recreation and Park Commission	Determination of project consistency with park use.		X	X			X
San Francisco Unified School District	Approval of use of property under its jurisdiction.			X			
Department of Public Health	Approval of well construction permit in accordance with California Department of Water Resources standards		X	X			X

TABLE 12: GROUNDWATER MASTER PLAN PROJECT APPROVALS (Continued)

Agency	Authority	GWMP	Elk Glen Well	Sunset Wells	Powell BART	In-Lieu Recharge	Monitoring Wells
San Francisco Voters	Approval of project facilities within City parks if Rec Park Commission determines it is inconsistent.		X	X			X
Regional							
Bay Area Rapid Transit District	Approval of use of property under its jurisdiction				X		
Daly City	Contractual agreement required for the sale of in-lieu water in exchange for cessation of pumping.					X	
San Bruno	Contractual agreement required for the sale of in-lieu water in exchange for cessation of pumping.					X	
California Water Service Company	Contractual agreement required for the sale of in-lieu water in exchange for cessation of pumping.					X	

SOURCE: Environmental Science Associates and Orion Environmental Associates, 1995.

ENVIRONMENTAL SETTING

CHAPTER IV
ENVIRONMENTAL SETTING

A. LAND USE AND VISUAL

REGIONAL

Though the program-level activities proposed in the GWMP may have effects beyond the County line, as could the distribution of water produced through implementation of both plans, the physical construction projects proposed in the RWMP and GWMP would take place almost entirely in the City and County of San Francisco (City). The only exception for construction outside of the City would be for installation of monitoring wells for the GWMP south of Lake Merced, which would be located in Daly City. Figure 1 (p. 2) shows the location of the City within the regional Bay Area. The City comprises approximately 47 square miles and had a population of almost 752,000 people in 1994.[1,2] San Francisco is an urbanized, densely populated city. Within the nine-county Bay Area, San Francisco is the fourth most populous county, and the second most populous city, after San Jose.[3]

CITY OVERVIEW

Existing Land Use

The majority of the proposed recycled water and groundwater facility projects and proposed users are located on the west side of the City, but projects are also proposed in other parts of the City. Both programs would have overall Citywide effects. The following discussion provides an overview of the developed land use types and patterns within the City. Figure 34 shows general residential land use patterns within the City. Figure 35 shows generally the City's neighborhood districts.

Residential development is the dominant land use in San Francisco as shown on Figure 34. Office and commercial retail uses are concentrated in the Civic Center and in the northeast sector of the City. There are also several neighborhood commercial corridors throughout the City. Industrial development occurs mainly in the southeastern sector of the City between

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1 Hing Wong, Regional Planner, Association of Bay Area Governments (ABAG), personal communication, December 28, 1994, 11:30 a.m.
2 California Department of Finance, *Demographic Research Unit, Report E-5*, January, 1994.
3 Association of Bay Area Governments, *Projections '95*, December 1993.

Residence Element
GENERALIZED RESIDENTIAL LAND USE PLAN

- **RESIDENTIAL**
  RH, RM Districts
- **MIXED USE**
  Predominantly Residential
  RC Districts
- **MIXED USE**
  Commercial/Residential/Industrial
- **PUBLIC/OPEN SPACE**
  P, OS Districts

SOURCE: City and County of San Francisco, General Plan Residential Element 1990

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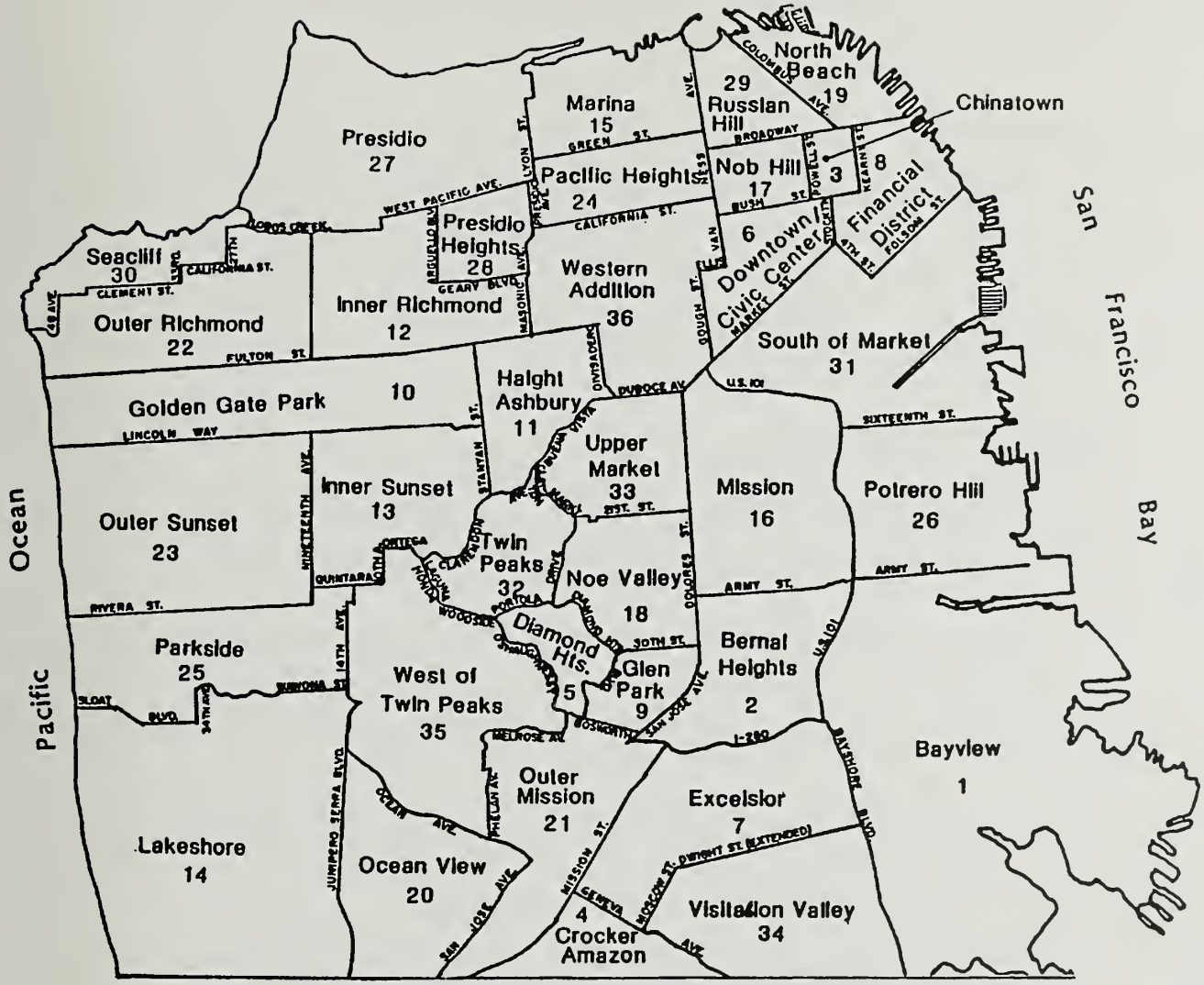
Figure 34
San Francisco Generalized Residential Land Use



SOURCE: City and County of San Francisco, Department of City Planning, Directory of Neighborhood Associations, December 1992

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Figure 35
San Francisco Neighborhood Districts

Highway 101 and the bay shoreline. The major open space areas are on the west side of the City and include the Presidio and Lincoln Park, Golden Gate Park, Stern Grove, Lake Merced and Harding Park area, and Ocean Beach. McLaren Park and Candlestick Park are located in the southeast corner of the City.

Table 13 summarizes the existing land use setting within each of the groundwater basins and each of the four proposed recycled water service areas. Please refer to Chapter III, Project Description, Figure 20 (p. 71), for a map of groundwater basins and Figure 9 (p. 32), for a map of the recycled water service areas.

Plans and Policies

San Francisco General Plan

The *San Francisco General Plan* contains policies in the Environmental Protection Element that are relevant to the general objectives of the RWMP and GWMP and they are as follows:

> *Objective 5: Assure a permanent and adequate supply of fresh water to meet the present and future needs of San Francisco.*
>
> > *Objective 5, Policy 1: Maintain an adequate water distribution system within San Francisco.*
> >
> > *Objective 5, Policy 5: Improve and extend the Auxiliary Water Supply System of the Fire Department for more effective fire fighting.*
>
> *Objective 6: Conserve and protect the fresh water resource.*
>
> > *Objective 6, Policy 2: Encourage and promote research on the necessity and feasibility of water reclamation.*

The City Planning Department would review the RWMP and GWMP projects for conformance with the objectives and policies of the *San Francisco General Plan.*

RECYCLED WATER MASTER PLAN PROJECT SITES

Recycled Water Treatment Plant - Fleishhacker Pool and Bath House Site

Existing Land Use

On-site. The Fleishhacker site is part of the San Francisco Zoological Gardens. It is located in the northwestern corner of the grounds of the San Francisco Zoological Gardens. The site lies

TABLE 13: EXISTING CITY-WIDE LAND USE

Groundwater Basin	Recycled Water Service Area	Chief Land Uses	City Neighborhoods
Westside - North Basin	Richmond and Sunset	1. Residential 2. Park/Open Space - Golden Gate Park; San Francisco Zoo; Lake Merced/Harding Park; Stern Grove Park; Twin Peaks/Mt. Sutro; Golden Gate Heights Park; McCoppin Park; golf courses 3. Neighborhood Commercial Corridors- East end of Irving, Noriega, and Taraval Streets; Sloat Drive near the Zoo; Portola Drive north of Sloat; Ocean Avenue near City College of San Francisco; Haight Street	Sunset (Inner and Outer); west end of Richmond; west end of Seacliff; Parkside; Lakeshore; West of Twin Peaks; Ocean View; west end of Haight-Ashbury
Westside - South Basin	NA	1. Residential 2. Park/Open Space - west side of San Bruno Mountain 3. Neighborhood Commercial 4. Industrial - San Francisco International Airport; South end of Point San Bruno	Colma; Daly City; South San Francisco; west side of Brisbane; northeast end of San Bruno; most of Millbrae; northeast corner of Burlingame
Lobos Basin	Richmond	1. Residential 2. Park/Open Space - Southwestern end of Presidio; Lincoln Park 3. Commercial - Along Geary Boulevard and Clement Streets; short sections of Balboa Street	east end of Richmond; Seacliff; Presidio Heights
Marina Basin	Richmond	1. Residential 2. Park/Open Space - Most of Presidio ; Aquatic Park, Marina Green 3. Commercial - Along Lombard, Chestnut, and Union Streets; Van Ness Avenue	Marina; north end of Pacific Heights
Downtown Basin	Downtown	1. Residential 2. Park/Open Space - Buena Vista Park; Corona Heights; Lafayette Park; Alta Plaza Park; Alamo Square; Mission Dolores Park; Civic Center Plaza; Justin Herman Plaza; Union Square 3. Neighborhood Commercial - Columbus Street; Van Ness Avenue; Pacific and Jackson Streets; Fillmore Street; Divisidero Street; around the Civic Center; south end of Market Street into the Castro; along 24th Street, Mission, Valencia and Guerrero Streets 4. Commercial - Downtown/Financial District; Mission Bay Proposed Mixed-Use development area	Downtown; Civic Center; Financial District; South of Market; Potrero Hill; the Mission; Upper Market; Noe Valley; east end of the Haight; Western Addition; Pacific Heights; Nob Hill; Chinatown; Russian Hill; North Beach
Islais Valley Basin	Southeast	1. Residential 2. Park/Open Space - Bernal Heights; Mt. Davidson Park; Glen Canyon Park; Balboa Park 3. Neighborhood Commercial - Along lower Mission Street and around Glen Park 4. Industrial (warehouse area in Outer Mission; Bayview)	Bayview; Bernal Heights; Glen Park; Diamond Heights; south end of Twin Peaks; Outer Mission; west end of Excelsior

TABLE 13: EXISTING CITY-WIDE LAND USE (Continued)

Groundwater Basin	Recycled Water Service Area	Chief Land Uses	City Neighborhoods
South Basin	Southeast	1. Residential 2. Park/Open Space - Bayview Park; north end of McLaren Park; Candlestick Park 3. Neighborhood Commercial - Along San Bruno Avenue; Third Street 4. Industrial - Hunters Point Naval Shipyard area, under study for reuse	south end of Hunters Point/Bayview; east end of Excelsior
Visitation Valley Basin	Southeast	1. Residential 2. Park/Open Space - south end of McLaren Park; San Bruno Mountain 3. Neighborhood Commercial - Bayshore Avenue; Leland Avenue 4. Industrial	Visitation Valley; Crocker/Amazon

SOURCE: Environmental Science Associates, 1995

between the visitor area of the Zoo to the east and the Great Highway/Pacific Ocean to the west, at the intersection of Sloat Boulevard and the Great Highway. An aerial photograph of the site and surrounding area is shown in Figure 36. Existing land uses are outlined on the photograph and discussed below. The property is owned by the City and County of San Francisco and is managed through a partnership between the San Francisco Recreation and Park Department and the not-for-profit San Francisco Zoological Society.[4]

The proposed Recycled Water Treatment Plant (RWTP) site is the site of the former Fleishhacker Pool and Bath House, a large salt water public pool and Bath House operated from 1925 to the mid-1970's. The 1,000-foot-long pool was filled in and covered (paved) in 1981. The Bath House is still standing, though it has been out of use since the 1980's.[5] (The history of the Fleishhacker Pool and Bath House is described further in Section IV.K, Cultural Resources, p. 243.) The majority of the Fleishhacker Pool and Bath House site is paved and used for surface parking by Zoo employees. The area is also used for materials storage and as a staging area for

4 San Francisco Zoological Society, San Francisco Zoological Gardens Master Plan Report Manual, June 1994.
5 City and County of San Francisco, Department of Public Works, *San Francisco Recycled Water Master Plan, Draft*, July 1996.

SOURCE: Environmental Science Associates, 1995

SF RWMP / GWMP Program EIR ■

Figure 36
Fleishhacker RWTP Site-
Existing Land Use

ongoing Zoo projects. Though the site is not currently open to public use, it is designated for public use.

Adjacent to the northwestern end of the parking lot is a vegetated berm which separates the Zoo property from the Westside Pump Station and Sloat Boulevard. South of the Westside Pump Station and berm, also west of the parking lot, is the abandoned Fleishhacker Bath House. The pump station, berm and Bath House are currently separated from the parking area by a chain-link fence. The parking area and Bath House are in the stewardship of the San Francisco Recreation and Park Department, and the pump station is managed by the San Francisco Department of Public Works.

Zoo. The San Francisco Zoological Gardens lie immediately adjacent to the RWTP site on the east. The main entrance to the Zoo is located on Sloat Boulevard at 45th Avenue, two blocks east of the plant site. Figure 37 shows the layout of exhibits, facilities and uses at the Zoo as they will exist by 1998, before construction of the RWTP would begin. The existing Zoo facilities and planned changes relevant to this impact analysis that will occur before plant construction is proposed to begin are summarized below.

As shown in Figure 37, the Barnyard/Children's Petting Zoo and Musk Ox Meadow are located within 200 feet of the project site, separated from the site by a 50- to 150-foot band of vegetation and assorted Zoo maintenance facilities. The Barnyard and Children's Petting Zoo are interactive exhibits which enable visitors to have contact with selected animals. The Musk Ox Meadow is a large grazing meadow with a visitor walkway along its eastern edge. The Insect Zoo and visitor service cafe lie adjacent to the Children's Petting Zoo, within 300 feet of the project site. All other existing Zoo exhibits are more than 750 feet from the proposed site, including Gorilla World, which is about 1,000 feet southeast of the site.

The Avian Conservation Center (ACC) has historically been located between the Children's Petting Zoo and the Musk Ox Meadow, adjacent to the Fleishhacker Pool and Bath House site. These facilities are being relocated to new, replacement facilities more than 1200 feet from the Fleishhacker Pool and Bath House site, before RWTP construction begins (see Figure 37).[6] The function of the ACC is breeding, management and study of birds, particularly those that are rare and endangered. Because of the sensitivity of these species, a new ACC is being constructed at a

[6] City and County of San Francisco, *Infrastructure Master Plan - Zoological Gardens, Draft Report*, December 1994.

SOURCE: Kennedy/Jenks Consultants, 1995
and Environmental Science Associates, 1995

SF RWMP / GWMP Program EIR ■

Figure 37
Fleishhacker RWTP Site-
Location Relative to Existing Zoo Facilities

greater distance from the activity of the public Zoo exhibits. The new ACC will be about 1200 feet southeast of the proposed RWTP site, and was completed in the fall of 1996.

The Animal Resource Center is located between the Children's Zoo and musk ox exhibit. It is managed by the Zoological Society and functions as the animal compound for the Education Department of the Zoo. The 66 animals associated with the Animal Resource Center are a "hands on collection" used for multiple Zoo programs, including educational programs for children and traveling exhibits for presentations outside the Zoo.[7]

There are two Zoo planning documents which are relevant to plans for RWTP construction: the *San Francisco Zoological Gardens Infrastructure Master Plan* (Zoo Infrastructure Master Plan) and the *San Francisco Zoological Gardens Master Plan* (Zoo Master Plan).[8,9] DPW is coordinating with the Zoo staff to develop RWTP design and construction plans which would be compatible with the existing uses and the uses proposed in the two Zoo planning documents for the Fleishhacker Pool site and vicinity. Figure 38 shows the proposed layout of the Zoo in the vicinity of the RWTP site, including the RWTP facilities and relevant components of the Zoo Master Plan and Infrastructure Master Plan projects. Figure 39 shows the proposed schedule for projects proposed in the two Zoo planning documents, as well as for RWTP construction. The Zoo Infrastructure Master Plan has been adopted by the Recreation and Park Commission and its environmental review have been completed. Implementation of Zoo Infrastructure Master Plan projects is scheduled to begin in the fall of 1996. Replacement of utility lines, including potable water, recycled water, groundwater, sewer, electricity, phone and gas, all in a single corridor, would proceed in one-hundred foot intervals throughout the Zoo between 1996 and 1999. The section of the utility corridor along the west side of the Zoo adjacent to the Fleishhacker RWTP site is scheduled to be replaced first, and will take between six months and one year to complete. This section of the corridor will therefore be complete before RWTP construction would begin in 1999.

In addition, the Zoo Infrastructure Master Plan proposes the construction of a new wet weather lift station and groundwater wells in the northwest corner of the Zoo, in the vicinity of the existing pump station. As shown on the schedule in Figure 39, these facilities are to be

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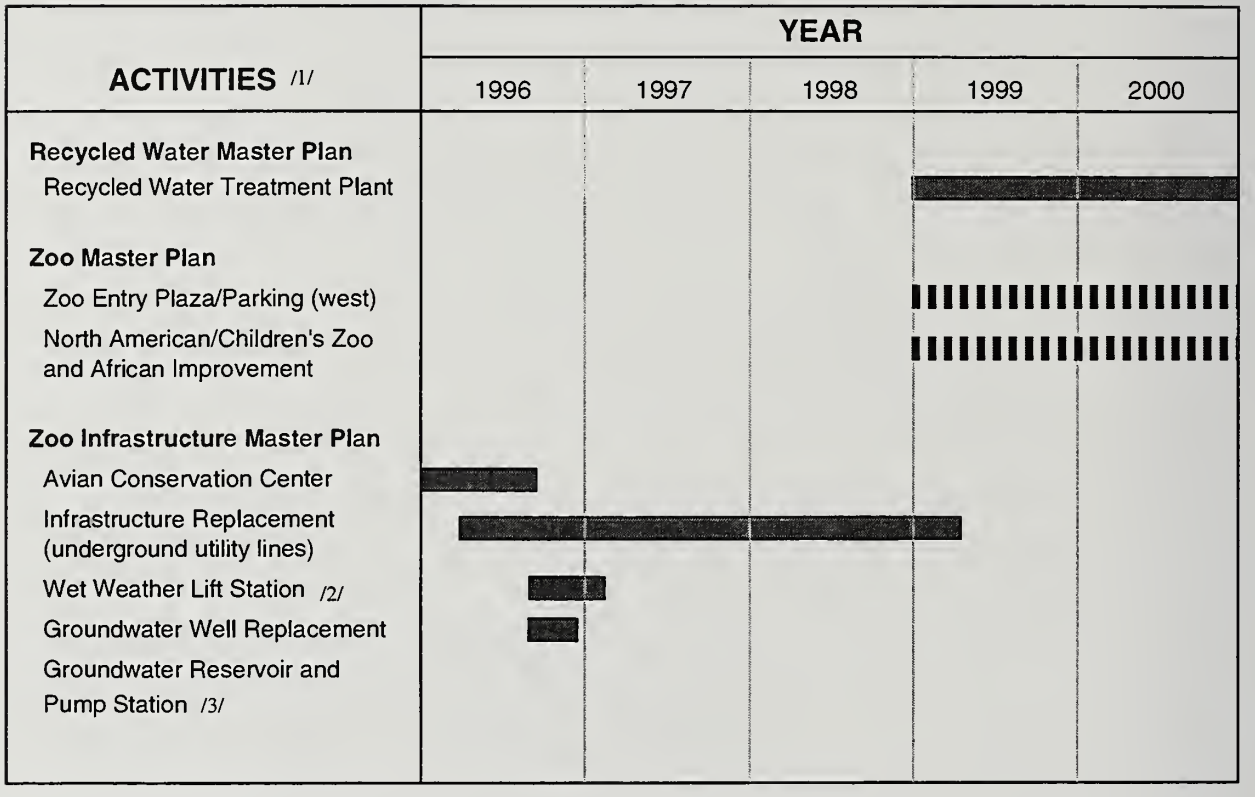
7 Fitting, Joe, Director, Animal Resource Center, personal communication, January 24, 1995, 10:45 a.m.
8 *San Francisco Zoological Gardens Infrastructure Master Plan, Final,* prepared by Kennedy Jenks - AGS, Inc., an Association, for the City and County of San Francisco Department of Public Works, August, 1995
9 *San Francisco Zoological Gardens Master Plan,* prepared by Portico, Inc., for the San Francisco Zoological Society, June 1994.

SOURCE: Kennedy/Jenks Consultants, 1995
and Environmental Science Associates, 1995

SF RWMP / GWMP Program EIR ■

Figure 38
Fleishhacker RWTP Site-
Location Relative to Proposed Zoo Facilities



/1/ Projects shown on this schedule are those that could take place within about 750 feet of the Fleishhacker RWTP site. Projects more than 750 feet away (South American Gateway), or minor/ongoing (landscaping work) are not shown on this schedule, except for the Avian Conservation Center (ACC). The ACC is listed on this schedule to clarify that this project will be complete and its sensitive inhabitants relocated more than 1500 feet from the RWTP site by the time RWTP construction begins. No other construction work will begin until this facility is complete and the sensitive animals are relocated. The North American/Children's Zoo and African Exhibit Improvement and Entry Plaza/Parking are shown with a dashed line because the exact design and and timing of these projects has not yet been determined. The Zoo Entry Plaza/Parking Project would be closely coordinated with the RWTP Project and would be constructed immediately following RWTP construction completion, if the proposed Zoo Master Plan is adopted.

/2/ Replacement of underground utility lines is scheduled to occur between spring of 1997 in a corridor around the Zoo. However, replacement of utility lines in the area adjacent to the RWTP site is scheduled to occur first, and will be complete before RWTP construction would begin.

/3/ To be determined.

SOURCE: Environmental Science Associates, 1996

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Figure 39
Schedule of Zoo and RWTP Projects

constructed between the summer of 1996 and the spring of 1997. Both will therefore be complete before RWTP construction would begin.

The Zoo Infrastructure Master Plan also includes plans for a new groundwater storage reservoir to be located on the north end of Fleishhacker Pool and Bath House site, and the construction schedule has not yet been determined. The design of the RWTP facilities and the Zoo Infrastructure Master Plan groundwater reservoir is being coordinated in order to make their timing, location and use compatible.

The Zoo Master Plan was produced in June 1994 and is currently undergoing environmental review. The Zoo Master Plan discusses the Zoo mission and interpretive themes, and outlines future physical improvements at the Zoo through the year 2000.[10] Physical improvements to the Zoo are generally described in the Zoo Master Plan and include alteration and rearrangement of animal exhibits into exhibits illustrative of biogeographic regions of the world, as well as expansion and rearrangement of support facilities. As shown in Figure 38, the proposed biogeographic regions to be located adjacent to the proposed RWTP site would be the "North American" and "African" exhibits. As shown in the schedule (Figure 39), Zoo Master Plan renovation of these exhibits could overlap with RWTP construction. Any simultaneous construction would need to be coordinated between the Zoo and the City.

The Zoo Master Plan also proposes to relocate the main Zoo entrance from Sloat Boulevard to the Great Highway, creating a new Entry Plaza and Parking Area on the Fleishhacker Pool and Bath House site (see Figure 38). The design of the Entry Plaza and Parking Area is being coordinated closely with that of the RWTP. The new parking area would be the main public parking area for the Zoo and would provide 865 visitor parking spaces. New vehicle entrance/exits would be constructed, one from the Great Highway (Highway 1 on the west) and one from Sloat Boulevard on the north.

A Mammal Conservation Center (MCC) has been planned for a site about 1200 feet south of the proposed RWTP site. This site would be jointly used by the MCC and the Oceanside Wastewater Treatment Plant (see Figure 38). The MCC would house multiple animal facilities. However, due to funding uncertainties, the construction schedule for the MCC facilities is not certain at this time.

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[10] *San Francisco Zoological Gardens Master Plan*, prepared by Portico, Inc., for the San Francisco Zoological Society, June 1994.

Sloat Boulevard. Across Sloat Boulevard (east of 47th Avenue and north of the proposed RWTP site) are commercial services including the Ocean Beach Cafe, Roberts Motel and the Doggie Diner (see commercial area outlined on Figure 36, p. 118). There is a vacant lot directly north of the project site at the corner of Sloat and Great Highway (2900 Sloat). The 0.52 acre lot is a former gas station site. The City is currently processing a development application to construct 33 residential units consisting of 15 duplex buildings and one triplex, along with 1,500 square feet of commercial retail space.[11] The residential units would be two to three stories above garage level to a maximum height of 40 feet. The project would be developed in four phases. Single- and multiple-family residences lie beyond the vacant lot, along Wawona Street, the Great Highway, and 47th Avenue. The closest existing homes to the site are along Wawona Street, about 450 feet from the site.

Oceanside WPCP. The Oceanside Water Pollution Control Plant (Oceanside WPCP or OWPCP) is located about 1800 feet south of the RWTP site, between Herbst Road, the Armory and Skyline Boulevard, and the Great Highway. The OWPCP is the newest of the three San Francisco WPCPs operated by the San Francisco Department of Public Works, and provides primary and secondary treatment for a design average dry weather capacity of 21 million gallons per day.[12] Secondary effluent from the OWCP would be conveyed to the proposed RWTP at the Fleishhacker site for tertiary treatment. Most of the OWPCP has been constructed below grade to accommodate plans for joint land use of the site by the OWPCP and the Zoo.[13]

The Rehabilitation Center for the Handicapped is located east of the Zoo, between Herbst Street and Skyline Boulevard, about 1,800 feet southeast of the RWTP site. Lake Merced and Harding Park lie beyond Skyline Boulevard about 2,300 feet southeast of the site.

Zoning

Figure 40 illustrates land use zoning and height and bulk districts for the RWTP site and the vicinity. The Zoo, including the Fleishhacker Pool and Bath House site, is within a P (Public Use) District. Principal permitted uses in P districts, identified in Section 234.1 of the City Planning Code, include public structures and uses of the City and County of San Francisco and other governmental agencies, including accessory non-public uses that conform to the *General*

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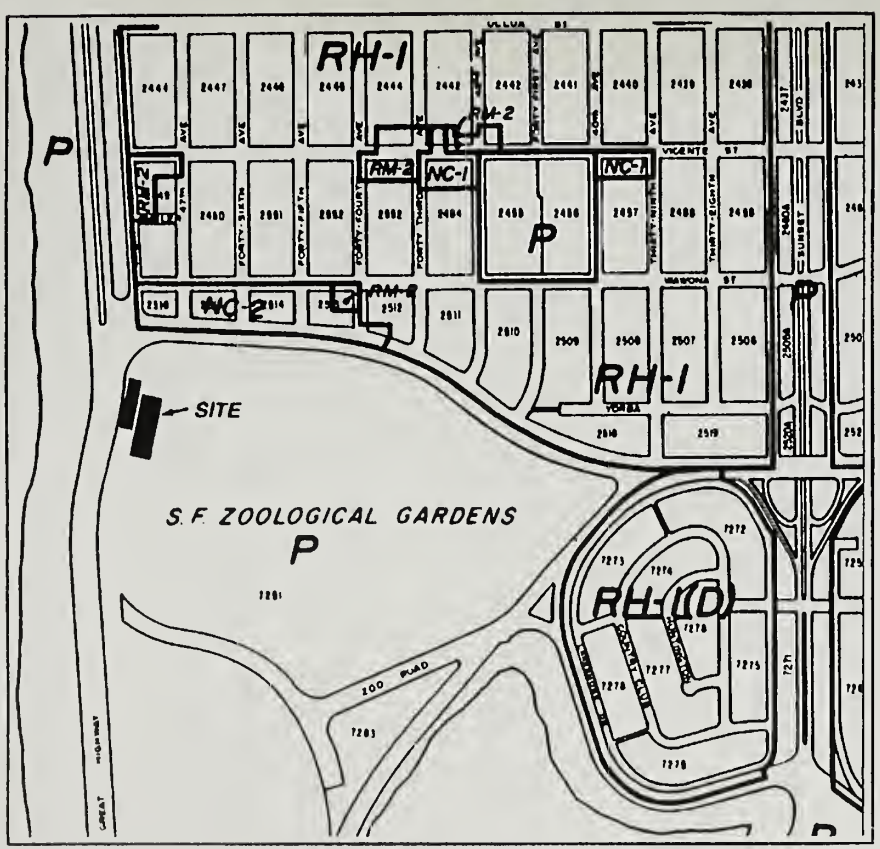
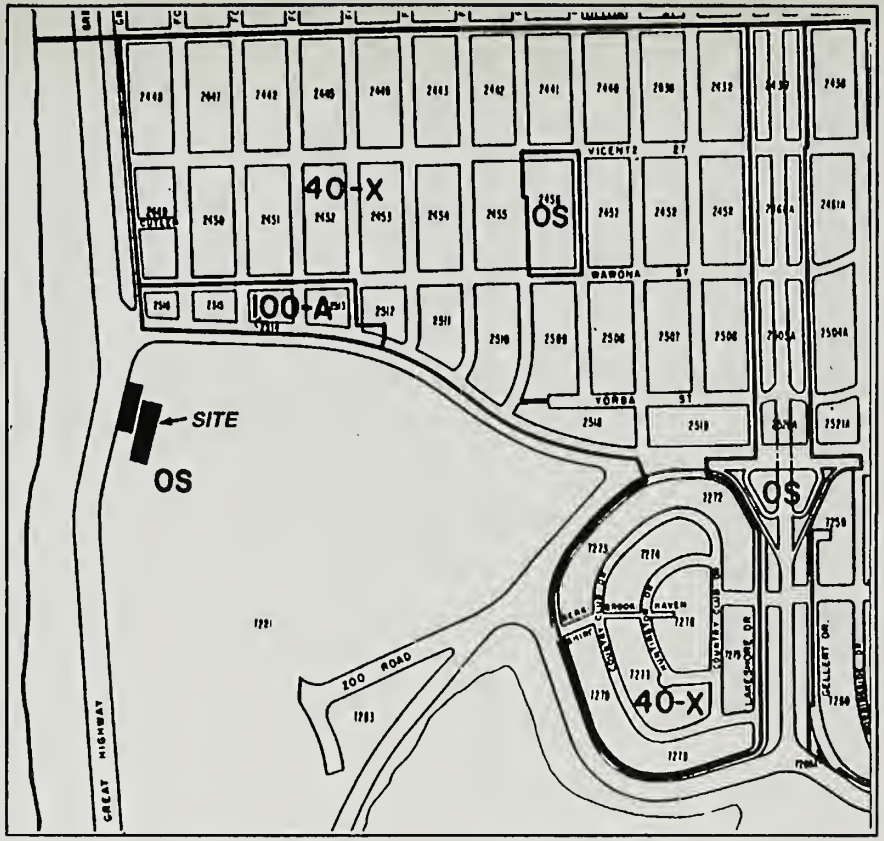
[11] City and County of San Francisco, Department of City Planning, *Final Negative Declaration for 93.586E, 2900 Sloat Boulevard*, January 6, 1994, and Notice of Proposed Project Revision, January 27, 1995.
[12] City and County of San Francisco, *Recycled Water Master Plan*, Draft, July 1996.
[13] City and County of San Francisco, Department of Public Works, *Mammal Conservation Center Program, San Francisco Zoological Gardens, Draft Report*, November, 1993.





ZONING

P	Public District
RH-1(D), RH-1, RH-2	Residential Districts
RM-2	Mixed House & Apartment Charcter Districts
NC-1, NC-2	Neighborhood Commercial Districts

HEIGHT AND BULK

OS	Open Space District
	Numbers are Height Limits in Feet
OO-Z	Letter Symbols Refer to Bulk Limits in City Planning Code Sec. 270

N

SOURCE: City and County of San Francisco Municipal Code, Planning Department, Zoning Maps, 1990

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Figure 40
Fleishhacker RWTP Site-
Zoning and Height and Bulk Districts

Plan. The surrounding area includes NC-2 (Small Scale Neighborhood Commercial) Districts to the north along Sloat Boulevard; RH-1 (Residential House, One-Family) Districts to the north; RH-1 (D) (Residential House, One-Family, Detached Dwellings) Districts to the east; and P (Public Use) Districts to the south (Lake Merced, Harding Park, and Fort Funston).[14]

The Fleishhacker Pool RWTP site is in the OS Height and Bulk District (see Figure 40). Section 290 of the *City Planning Code* states that the height and bulk of buildings and structures in the OS District shall be determined in accordance with the objectives, principles and policies of the *General Plan*, and no building or structure or addition thereto shall be permitted unless in conformance with the *General Plan*. The surrounding area includes OS, 40-X and 100-A Height and Bulk Districts. The City Planning Commission would evaluate the appropriateness of the proposed facility for the OS Height and Bulk District at the Fleishhacker Pool and Bath House site in the context of the *General Plan*.

Plans and Policies

San Francisco General Plan. The *San Francisco General Plan* contains policies in the Environmental Protection, Community Facilities and Recreation and Open Space elements that are relevant to the RWTP Fleishhacker Pool and Bath House site.

As part of its permit review process, the City Planning Commission would make a determination regarding conformance of the proposed RWTP at the Fleishhacker Pool and Bath House site with the following relevant objectives and policies of the *San Francisco General Plan:*

Community Facilities

Objective 10: Locate wastewater facilities in a manner that will enhance the effective and efficient treatment of storm and wastewater.

Recreation and Open Space Element

Objective 1, Policy 2: Make open space lands already in public ownership accessible to the public for compatible recreational uses.

Objective 4, Policy 2: Maximize joint use of other properties and facilities.

Objective 4, Policy 3: Renovate and renew the city's parks and recreational facilities.

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[14] City and County of San Francisco, *City and County of San Francisco Municipal Code, Zoning Map, Sheet 13*, September 30, 1990.

Urban Design Element

Objective 2, Policy 6: Respect the character of older development nearby in the design of new buildings.

Western Shoreline Area Plan

The Western Shoreline Plan, a special area plan of the City's Master Plan, contains policies that are relevant to the RWMP and GWMP under sections for The Zoo. Under The Zoo, the following policies would relate to the RWMP:

Policy 3: Allow location of a sewage treatment plant and pump station to serve the western area of San Francisco on Zoo property. Locate and design the facilities to maximize their joint use by the Zoo.

Policy 4: Expand the existing Zoo area west toward the Great Highway and south toward Skyline Boulevard.

Policy 5: Provide a wind berm along the Great Highway for protection and public view of Ocean Beach and the Pacific Ocean.

Policy 6: Enhance the entrance to the Zoo by providing visitor amenities at the northwest corner.

Environmental Protection

Objective 12, Policy 1: Incorporate energy management practices into building, facility, and fleet maintenance and operations.

Objective 12, Policy 3: Investigate and implement techniques to reduce municipal energy requirements.

Section 295 of the *City Planning Code* prohibits the issuance of building permits for structures that would shade property under the jurisdiction of, or designated to be acquired by, the Recreation and Park Commission unless the City Planning Commission, in consultation with the Recreation and Park Commission, determines that such shade would have an insignificant adverse impact on the use of such property. Section 295 applies only to structures which exceed a height of 40 feet; proposed project facilities would not exceed 40 feet in height.

City and County of San Francisco/San Francisco Recreation and Park Department. The Fleishhacker Pool RWTP site is part of the San Francisco Zoological Gardens. The property is owned by the City and County of San Francisco, and the Zoo is managed through a partnership between the San Francisco Recreation and Park Department and the not-for-profit San Francisco Zoological Society.[15]

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15 San Francisco Zoological Society, *San Francisco Zoological Gardens Master Plan Report Manual*, June 1994.

In accordance with *City Charter* Section 4.113, lands that have been dedicated for park and recreation use cannot be used for non-recreational activities without voter approval. If the Recreation and Park Commission determines that use of the Fleishhacker Pool and Bath House site for a RWTP would not be consistent with recreational use of the site, then voter approval would be required to allow such use on the site.

California Coastal Commission. The Fleishhacker Pool and Bath House site lies within the Coastal Zone in an area under jurisdiction of the State Coastal Commission. The State Coastal Commission has delegated permitting authority in this urbanized area to the San Francisco City Planning Commission. The San Francisco City Planning Commission would therefore review the project for consistency with Local Coastal Program and would be required to take action regarding issuance of a Coastal Development Permit, in accordance with Section 30412 of the California Coastal Act of 1976.[16]

Existing Visual Setting

The Fleishhacker Pool and Bath House site currently includes the abandoned Bath House structure along the west side of the site and a paved parking lot used by Zoo employees for parking and for materials storage, as described previously under "Existing Land Use" (pp. 115 to 119). With the exception of the driveway leading from the site to Sloat Boulevard, the site is largely surrounded by mature vegetation, which obscure views of the surrounding area from the site (see Figure 36, p. 118). Public viewpoints of the Fleishhacker Pool and Bath House site are extremely limited. On the west, views of the site from the Great Highway at Sloat Boulevard are obscured by a vegetated berm and the Westside Pump Station. The Bath House is visible from the Great Highway and the public beach parking lot across the street. Further south along the Great Highway, dense landscaping of mature trees and shrubs blocks views of the site. There are no public views from the south due to the bermed topography of the Oceanside WPCP site and landscaping along the Zoo access road which is restricted to employee use only. From within the Zoo exhibits to the east (i.e., Children's Petting Zoo and Musk Ox Meadow), views of the site are completely obscured by dense landscaping and utility buildings. The single public viewpoint of the site is a set of two driveways leading from the site north to Sloat Boulevard. The driveways are closed by a chain link fence, providing an approximately 25-foot view window through which the site can be viewed from the sidewalk or Sloat Boulevard.

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[16] City and County of San Francisco, *The Western Shoreline Area Plan of San Francisco Master Plan*, Adopted April 18, 1985, amended December 17, 1987.

Lincoln High School - Reservoir Site and McCoppin Square Park - Construction Staging Area

Existing Land Use

Lincoln High School is a public high school serving about 2,000 students located in the Sunset District of San Francisco.[17] The school property is owned and operated by the San Francisco Unified School District. The proposed reservoir site is the school's football field in the Sebastian C. Passanisi Stadium. The site consists of an oval-shaped grass field surrounded by a sand/dirt running track, flanked by bleachers to the east and west and a scoreboard, batting cages and exercise stations to the south. Existing on-site and surrounding land uses are shown on an aerial photograph of the site in Figure 41 and are discussed below.

The school yards, including the football field, are multi-elevational. The school property slopes downhill from northeast to southwest. The three- and four-story school buildings are located at a higher elevation immediately to the north of the football field, as are the school's basketball courts and tennis courts. The basketball courts and tennis courts are used by the public in the evenings year-round. The school buildings are also used year-round; summer school occurs when regular school is not in session. The football field is used for football in the winter, track in the spring, and for Physical Education classes during the school day all school year. In addition, class assemblies and rallies are held periodically on the field. During the summer, the field is not scheduled for summer school use, nor is it leased for other purposes.[18] Another grass play field is located west of the football field at a lower elevation. This field is owned by the School District but is not formally used or maintained because it is not level.[19]

In general, land use in the vicinity of the Lincoln School site is residential and park/open space. The closest potentially sensitive land uses, besides the school itself, are single-family homes across 22nd Avenue from the school. These homes lie about 100 feet east of the site, separated from the site by stadium bleachers and a perimeter cement wall. Along 24th Avenue, west of the school's practice football field, single-family homes are within about 300 feet of the site. The Sunset Reservoir, a potable water reservoir, covers eight square blocks northwest of Lincoln High School, between 24th, 28th, Quintara and Ortega avenues.

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[17] Student population was 2,054 in the 1993-1994 school year, according to San Francisco Unified School District, *District and School Profile, 1993-1994.*

[18] Hong, Betty, Project Manager, San Francisco Unified School District, personal communication, December 29, 1994, 10:30 a.m.

[19] ibid.

SOURCE: Environmental Science Associates, 1995

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Figure 41
Lincoln Reservoir Site / McCoppin Square Park
Staging Area - Existing Land Use

McCoppin Park is across Santiago Avenue from the Lincoln High School Reservoir site. This park is managed by the San Francisco Recreation and Park Department. The northern end of McCoppin Park is a grassy baseball field which lies below street level, surrounded by gentle slopes and scattered mature trees. The level part of this grassy area, and the adjacent portion of Santiago Street, is proposed to serve as a construction staging area for reservoir construction at the Lincoln High School site. McCoppin Park extends south to Taraval Street, and also contains a playground, the Rainbow Montessori Preschool, and the Parkside Public Library. The park is surrounded mainly by residential development to the east and west, with commercial development (Walgreens, Kentucky Fried Chicken and others), along Taraval Street one block to the south. On 24th Avenue across from McCoppin Park, the Taraval police station is being renovated; renovation is scheduled to be complete by spring of 1996.

The Lincoln High School site is three blocks west of 19th Avenue and would most likely be accessed for construction and operation from 19th Avenue, using Rivera, Taraval, and Santiago streets. Nineteenth Avenue is a major city corridor with commercial and residential adjacent land uses. Land uses along Santiago and Rivera streets are mainly single family residential and park/open space (McCoppin Park), and Taraval Street is mixed-use, containing both residential and commercial uses.

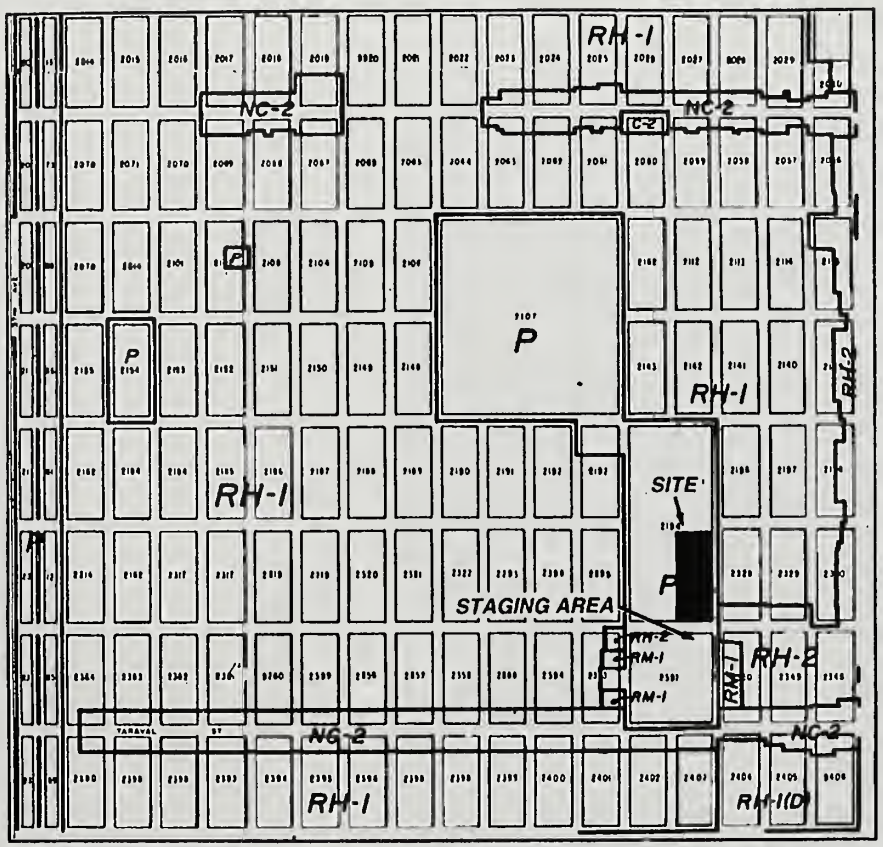
Zoning

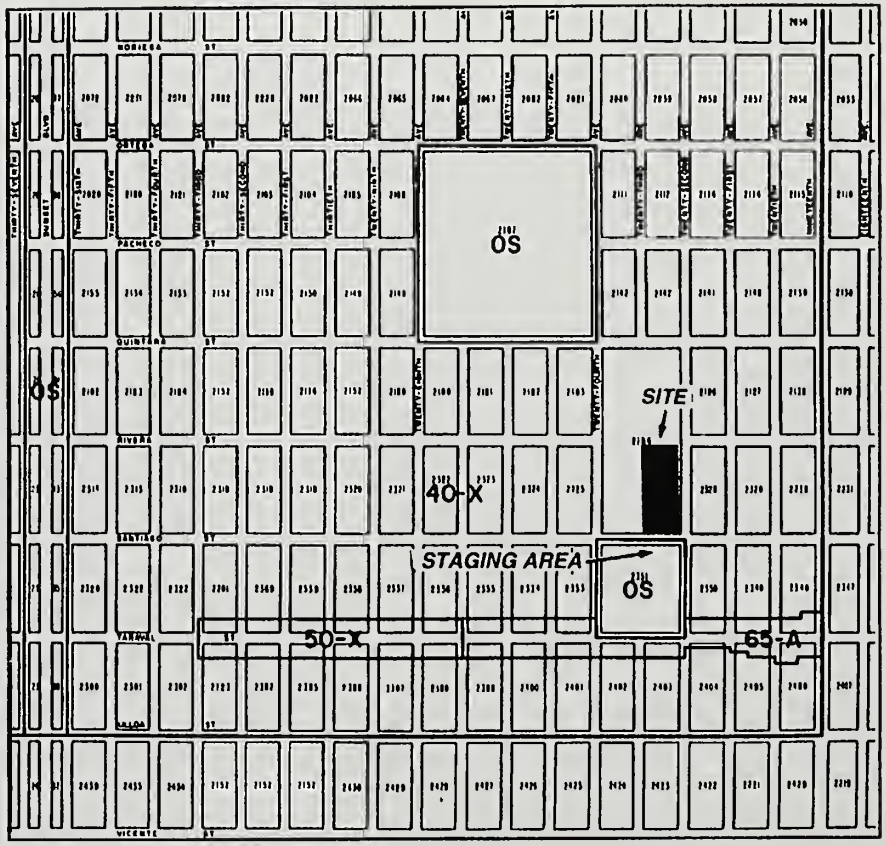
Zoning and height and bulk designations are shown on Figure 42. The site is zoned P, for Public Use District, as are the adjacent McCoppin Park and Sunset Reservoir and nearby police station. North, east and west of the site, properties are zoned RH-1, Residential, House, One-Family District. Along Santiago Street to the southeast of the site, properties are zoned RH-2, Residential, House, Two-Family District, and on either side of McCoppin Park, properties are zoned RH-1, and RM-1, Residential, Mixed, Low-Density Districts. Along Taraval, one block south of the site, the zoning is NC-2, Small-Scale Neighborhood Commercial District.[20]

Plans and Policies

The *San Francisco General Plan* contains policies in the Recreation and Open Space Element that are relevant to the Lincoln High School Reservoir Site. Objective 4, Policies 2 and 3 encourage maximizing "joint use of other properties and facilities" and renovating and renewing

[20] City and County of San Francisco, *City and County of San Francisco Municipal Code, Zoning Map, Sheet 5*, September 30, 1990.





ZONING

P Public District

RH-1(D), RH-1, RH-2, RM-1, RM-2 Residential Districts

C-2, NC-1, NC-2 Neighborhood Commercial Districts

HEIGHT AND BULK

OS Open Space District

Numbers are Height Limits in Feet

OO-Z — Letter Symbols Refer to Bulk Limits in City Planning Code Sec. 270

N

SOURCE: City and County of San Francisco Municipal Code, Planning Department, Zoning Maps, 1990

SF RWMP / GWMP Program EIR ■

Figure 42

Lincoln Reservoir Site / McCoppin Square Park Staging Area-
Zoning and Height and Bulk Districts

"the city's parks and recreational facilities." As part of its permit review process, the City Planning Department would make a determination regarding conformance of the proposed reservoir and pump station at the Lincoln High School Site with the objectives and policies of the *San Francisco General Plan.*

The San Francisco Unified School District has not proposed any plans for alteration to or expansion of the football field or field activities.[21] There is no planning document for McCoppin Park.

Visual Setting

As discussed above, the existing visual appearance of the Lincoln High School site is a high school football field, consisting of an oval-shaped grass field surrounded by a sand/dirt running track, flanked by bleachers to the east and west and a score board, batting cage and exercise stations to the south (see Figure 41, p. 131). Located on school property, the site is visible from all sides. However, public views of the site from points outside of the school yard are limited due to obscuring topography, vegetation and walls. The only potential public view of the site would be from the sidewalk adjacent to the driveway entrance to the football field, on 22nd Avenue. Unobstructed and partially obstructed views of the McCoppin Park staging area would be available from 22nd and 24th Avenues; Santiago Road would be closed to public traffic between these streets.

McLaren Park - Reservoir Site

Existing Land Use

Two reservoir site alternatives have been identified in McLaren Park. McLaren Park is a 318-acre park between Alemany Boulevard and Geneva Avenue.[22] The two sites are located along the John F. Shelley Drive loop road in the northern portion of the park. Existing land uses on and around the sites are shown on an aerial photograph, Figure 43.

Site 1. Site 1 is adjacent to the existing Upper Reservoir on John F. Shelley Drive. The reservoir footprint on this site would underlie an existing 42-space parking lot, as well as part of the road and open space surrounding the parking lot. The existing surface reservoir called

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[21] Hong, Betty, Project Manager, San Francisco Unified School District, personal communication, December 29, 1994, 10:30 a.m.

[22] City and County of San Francisco, *John McLaren Park Master Plan*, February, 1989.

1 Upper Reservoir
2 Upper Reservoir Parking Area
3 Amphitheater
4 Luther Burbank Junior High School
5 Louis Sutter Playground

✱ Play Area
(R) Residential

SOURCE: Environmental Science Associates, 1995

SF RWMP / GWMP Program EIR ■

Figure 43
McLaren Park Reservoir Sites-
Existing Land Use

Upper Reservoir lies downslope of the site, to the east. The Upper Reservoir is owned and operated by the San Francisco Recreation and Park Department to provide water for irrigation within the park.[23] The Upper Reservoir is surrounded by a chain link fence and a cement path which is accessed from the parking lot. Slopes adjacent to the reservoir are landscaped, and picnic tables and benches have been provided for park visitors.

Across Shelley Drive from the parking lot is a grassy slope, traversed by three interconnected cement paths. The paths are accessed from the surrounding residential neighborhoods and from other trails within the park. Park visitors use the trails for dog walking and for accessing other park resources. At the base of this slope are the nearest residences to the site. The back sides of single-family, two-story homes face the site, located about 250 feet away from Shelley Drive, at the end of Prague Street. Other houses line Excelsior and Munich streets at a greater distance from the site to the west.

Above Site 1 on a hill to the northwest, there is a water tank. Further north along Shelley Drive on the other side of the hill crest about 325 feet from the site, still within McLaren Park, there is a play area which includes basketball hoops, a sand area and two swings, with several picnic tables and barbecues nearby.

Site 2. The proposed Site 2 is located on Mansell Street immediately north and northeast of the turn-off on to John F. Shelley Drive. The site could accommodate two reservoirs with a combined storage capacity of 15 million gallons. The site consists of a level grassy area and a series of ridges or shoulders and intervening swales, vegetated with unmaintained grasses and scattered mature trees. Informal dirt paths criss-cross the hillsides in the vicinity of Site 2, one descending into the wooded area downslope and northeast of the site, and one, a dirt road, crossing the site roughly east-west. These paths appear to be regularly used by park visitors for walking, but do not appear to be maintained. The existing use of Site 2 is undeveloped park/open space.

The area surrounding the Site 2 is also undeveloped park/open space. About 600 feet north of the site lies the park's amphitheater, which can seat about 500 people, but which is currently used very infrequently.[24] A rehabilitation plan is underway to refurbish the amphitheater.[25] The

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[23] Deborah Learner, Recreation and Park Department, letter to Paul Maltzer, Office of Environmental Review, dated May 22, 1995.
[24] City and County of San Francisco, *John McLaren Park Master Plan*, February, 1989.
[25] Deborah Learner, Recreation and Park Department, letter to Paul Maltzer, Office of Environmental Review, dated May 22, 1995

closest residences to the site are to the north at the end of Cambridge Street, and or to the south at the end of Raymond Avenue, both outside the park, about 1,100 feet from the site. Site 2 is in the vicinity of a proposed park visitor center.[26]

Both sites would be accessed using the Paul Avenue Exit from Highway 101, to Mansell Street, to John F. Shelley Drive. Between the park and the freeway, Mansell Street is surrounded by single and multi-family residences. Within the park, Mansell Street and John F. Shelley Drive are surrounded by park/open space.

Zoning

Zoning and height and bulk designations are shown on Figure 44. The three sites are entirely within McLaren Park, zoned P, Public Use District. Properties surrounding the park are zoned mainly RH-1, Residential, House, One-Family District, with areas south of the park along Sunnydale, Brookdale and Geneva zoned RM-1, Residential, Mixed Low Density Districts, One-Family, RH-2, Residential, House, Two-Family Districts, NC-S Neighborhood Commercial Shopping Center District, and NC-1, Neighborhood Commercial Cluster District.[27] Height and bulk designation for the park is OS, Open Space District, and surrounding properties are 40-X.[28]

Plans and Policies

San Francisco General Plan. The *San Francisco General Plan* contains policies in the Recreation and Open Space Element that are relevant to the McLaren Park Reservoir Site. Objective 4, Policies 2 and 3 encourage maximizing "joint use of other properties and facilities" and renovating and renewing "the city's parks and recreational facilities." Also, Objective 2, Policy 11 states that McLaren Park should be developed "into a high quality, city serving park." The McLaren Park Master Plan implements this policy, and it is discussed below. As part of its permit review process, the City Planning Department would make a determination regarding conformance of the proposed reservoir at the McLaren Park Site with the objectives and policies of the *San Francisco General Plan.*

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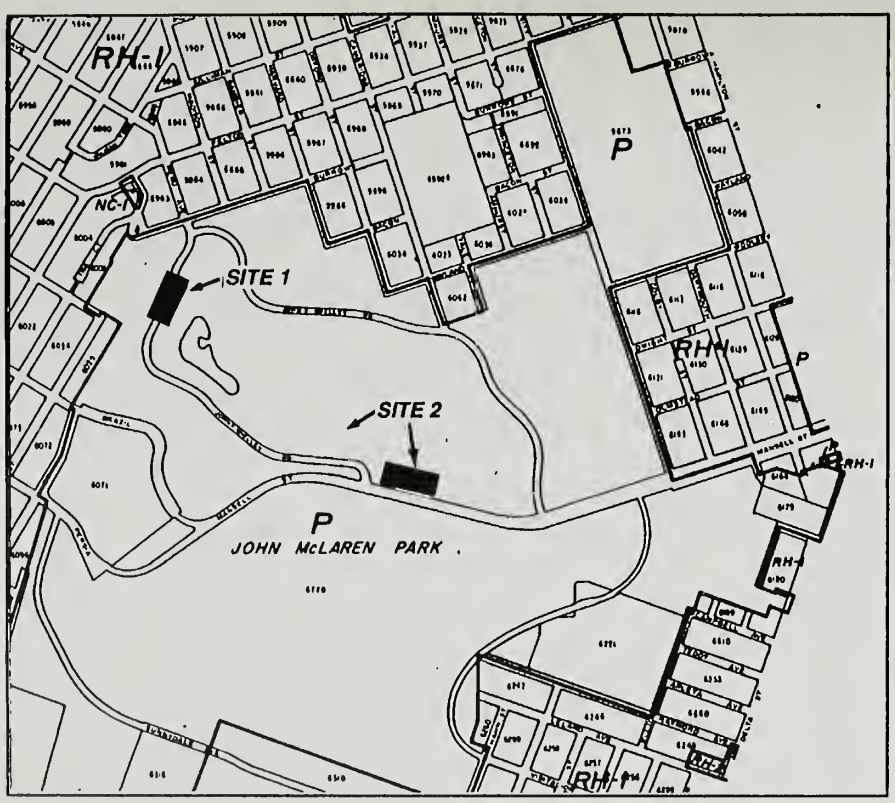
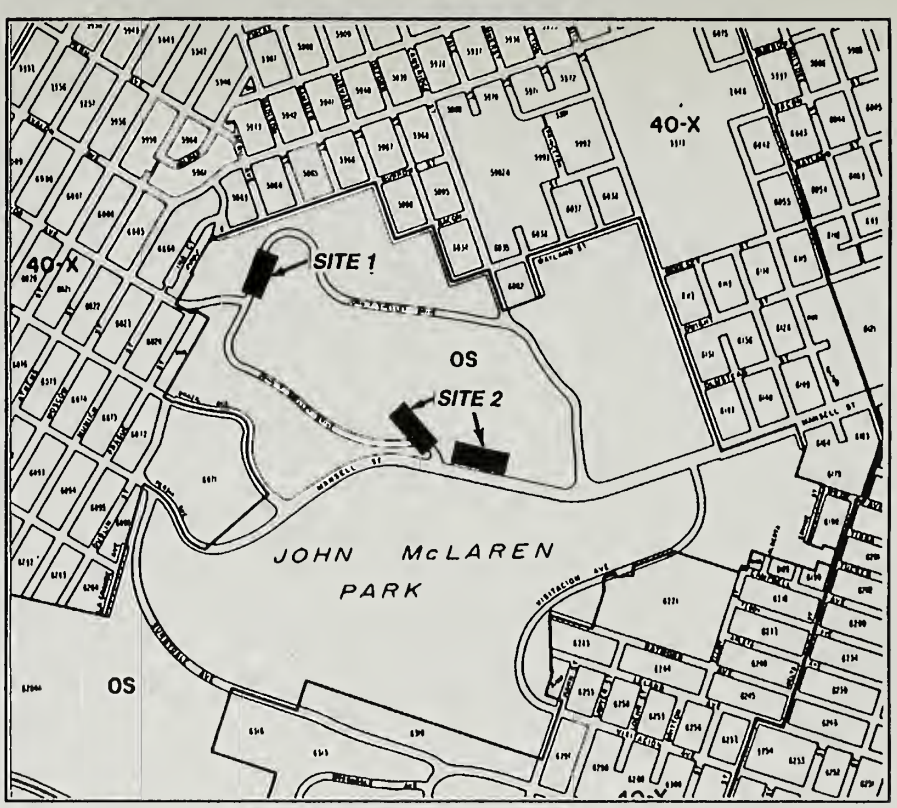
[26] City and County of San Francisco, *John McLaren Park Master Plan*, February, 1989.
[27] City and County of San Francisco, *City and County of San Francisco Municipal Code, Zoning Map, Sheet 11*, September 30, 1990.
[28] City and County of San Francisco, *City and County of San Francisco Municipal Code, Zoning Map, Sheet 11H*, September 30, 1990.





ZONING

P	Public District
RH-1, RH-2	Residential Districts
NC-1	Neighborhood Commercial Districts

HEIGHT AND BULK

OS	Open Space District
Numbers are Height Limits in Feet	
OO-Z	Letter Symbols Refer to Bulk Limits in City Planning Code Sec. 270

N

SOURCE: City and County of San Francisco Municipal Code, Planning Department, Zoning Maps, 1990

Figure 44
McLaren Park Reservoir Sites-
Zoning and Height and Bulk Districts

If the Recreation and Park Commission determines that use of McLaren Park for a reservoir would not be consistent with recreational use of either Site 1 or 2, then voter approval would be required to allow such use on either site.

John McLaren Park Master Plan. In 1989, the John McLaren Park Master Plan was updated. The updated Park Master Plan proposed that a Park Visitor Center be constructed on the level grassy site adjacent to (north of) Shelley Drive after its turn-off from Mansell Road.[29] This proposed Visitor Center site overlaps with reservoir Site 2. This center was listed as one of the high priority developments in the Park Master Plan but no specific schedule for construction has been set. The Park Master Plan also proposed a wide variety of other additions/alterations, including protective plantings (wind breaks) and reforestation, and various park infrastructure improvements. The Park Master Plan also includes a plan for construction of a trail along Mansell Road on its southern side, which would link other trails in the park, creating a multi-purpose park-wide trail loop.[30]

Visual Setting

The visual character of Site 1 consists of a 42-space paved parking lot, open space (grassy field) surrounding the parking lot, and part of John F. Shelley Drive adjacent to the parking lot on the west, as shown in Figure 43, p. 135. The site overlooks Upper Reservoir to the east, and provides views of the backs of residences on Prague Street are apparent to the west of the site. Site 1 is visible from John F. Shelley Drive. Visitors have unobstructed views of the site by car and on foot, and some residents at the end of Prague Street have views of the site from the windows at the backs of their homes. Immediate views are available from paved pathways which run across and adjacent to the site, both on the hill south of Shelley Drive, and from the parking lot down to the Upper Reservoir. The site is less visible from the Upper Reservoir area below due to the steep slope between the two, and vegetation beside a chain link fence alongside the parking lot. If construction affected this vegetated slope, views of the site could be more accessible from the Upper Reservoir. Views from residences along Excelsior and Munich Roads are obstructed by vegetation and other houses, but are still possible.

Site 2 consists of a level grassy area and a series of ridges and swales, covered with grasses and scattered mature trees, as shown in Figure 43, p. 135. The site offers panoramic views of McLaren Park and adjacent residential areas to the north, with ground level views of the park and

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[29] City and County of San Francisco, *John McLaren Park Master Plan*, February, 1989.
[30] ibid.

wooded areas to the south. Site 2 is visible from both Mansell Road and Shelley Drive, which run alongside the site. There is no sidewalk adjacent to either of the roads alongside Site 2, nor is there a paved path in the site vicinity, but the site is regularly viewed by hikers using the informal dirt paths which traverse the site.

Transmission and Distribution Pipelines

Existing Land Use

Transmission Pipelines to the Reservoir at Lincoln High School. The Phase I transmission pipeline from the RWTP to the Lincoln High School reservoir site would run alongside the San Francisco Zoological Gardens and mixed commercial and residential land uses for two blocks on Sloat Boulevard, and through mainly residential uses along the remainder of its route along 45th Avenue and Santiago Street.

Other Transmission and Distribution Pipelines. The remaining transmission and distribution pipeline corridors related to the Fleishhacker RWTP Site and the Lincoln and McLaren Park Reservoir sites would run through a variety of San Francisco districts including the Outer Richmond, Golden Gate Park, Outer Sunset, Parkside, Lakeshore, Ocean View, Outer Mission, Excelsior, Visitacion Valley, and Bayview districts. The pipelines would extend primarily through residential areas, and, to a lesser degree, through commercial areas and public property, including school, Zoo, and park property.

GROUNDWATER MASTER PLAN PROJECT SITES

Elk Glen Well

Existing Land Use and Zoning

Elk Glen Well is located on the northeast side of Elk Glen Lake in Golden Gate Park, near the intersection of Middle Drive West and Transverse Drive. The well is currently being used for park irrigation. The Elk Glen Well and pump are housed in a 13.5- by 27-foot chain link fence enclosure on the northeast end of the lake. The fence enclosure is on a grassy slope five to ten feet from the lake path, and twenty-five to thirty feet from the lake. The existing on-site and surrounding land uses are open space/park as shown on Figure 45, an aerial of the site and surrounding area.

1 Elk Glen Lake
2 Sunset Reservoir (existing)
3 Ocean Beach
R Residential

SOURCE: Environmental Science Associates, 1996

SF RWMP / GWMP Program EIR ■

Figure 45
Elk Glen and Sunset Wells Sites-
Existing Land Use

Elk Glen Lake is a 1.8-acre lake in a wooded valley between two park roads. The lake serves as a water system reservoir and provides a naturalistic setting for walking, horseback riding and other park enjoyment activities. The lake has natural soil edges, along sections of which there is marsh and riparian vegetation. The surrounding slopes are vegetated with grasses, shrubs, mature trees and other vegetation, including a recently planted hill of young orchard trees on the northeast end of the lake. A narrow dirt pathway encircles the lake. There is a park bench adjacent to the lake about fifty feet from the existing pump enclosure. Another pump station and cement pump station enclosure lie on the lake's edge at the opposite end of the lake from the site.

Elk Glen Lake is one of the fourteen Golden Gate Park lakes. The character, maintenance and restoration of these lakes is discussed in the Golden Gate Park Master Plan.[31] Objectives and policies of the Golden Gate Park Master Plan relevant to the proposed well project include the following:

> *Objective I - Land Use and Activities: Ensure that land uses and activities in Golden Gate Park contribute to the mission and purpose of the park. The activities within a designated land use zone should be appropriate to the land use purpose.*
>
> > *Policy A - Naturalistic Parkland: Naturalistic parkland...must be preserved to protect the pastoral character of the park and to ensure the retention of park open space. Naturalistic parkland...gives the park its visual character.*
> >
> > > *1. Areas designated as "Naturalistic Parkland" include the park's woodlands and most of the scenic lakes, ponds, marshes, watercourses and wildlife habitats.*
>
> *Objective IV - Buildings, structures and monuments: Minimize the impacts that buildings and monuments have on the park landscape, and preserve the open space of Golden Gate Park.*

The Elk Glen site and surrounding area are zoned P, Public District, with an OS, Open Space, Height and Bulk limit. Zoning and Height and Bulk designations for the site and surrounding area are shown on Figures 46 and 47. The Rec Park Commission must make a determination of whether the proposed well and chlorination facility are consistent with the City park uses. In the event the Commission determines they are not, the City Charter requires a public vote on the proposed use.

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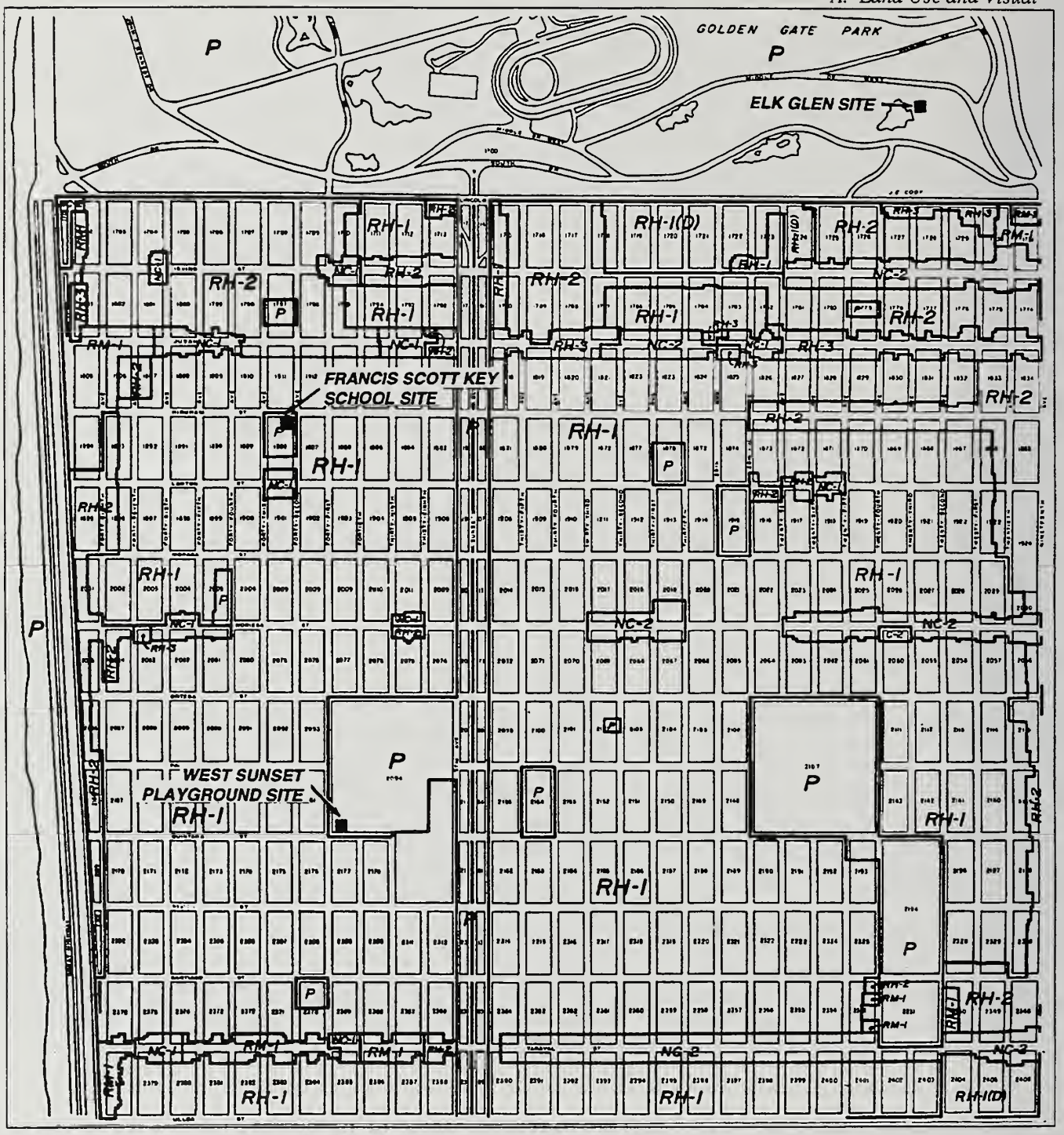
[31] San Francisco Recreation and Park Department, *Golden Gate Park Draft Master Plan*, March 1995.



SOURCE: City and County of San Francisco Municipal Code, Planning Department, Zoning Maps, 1990

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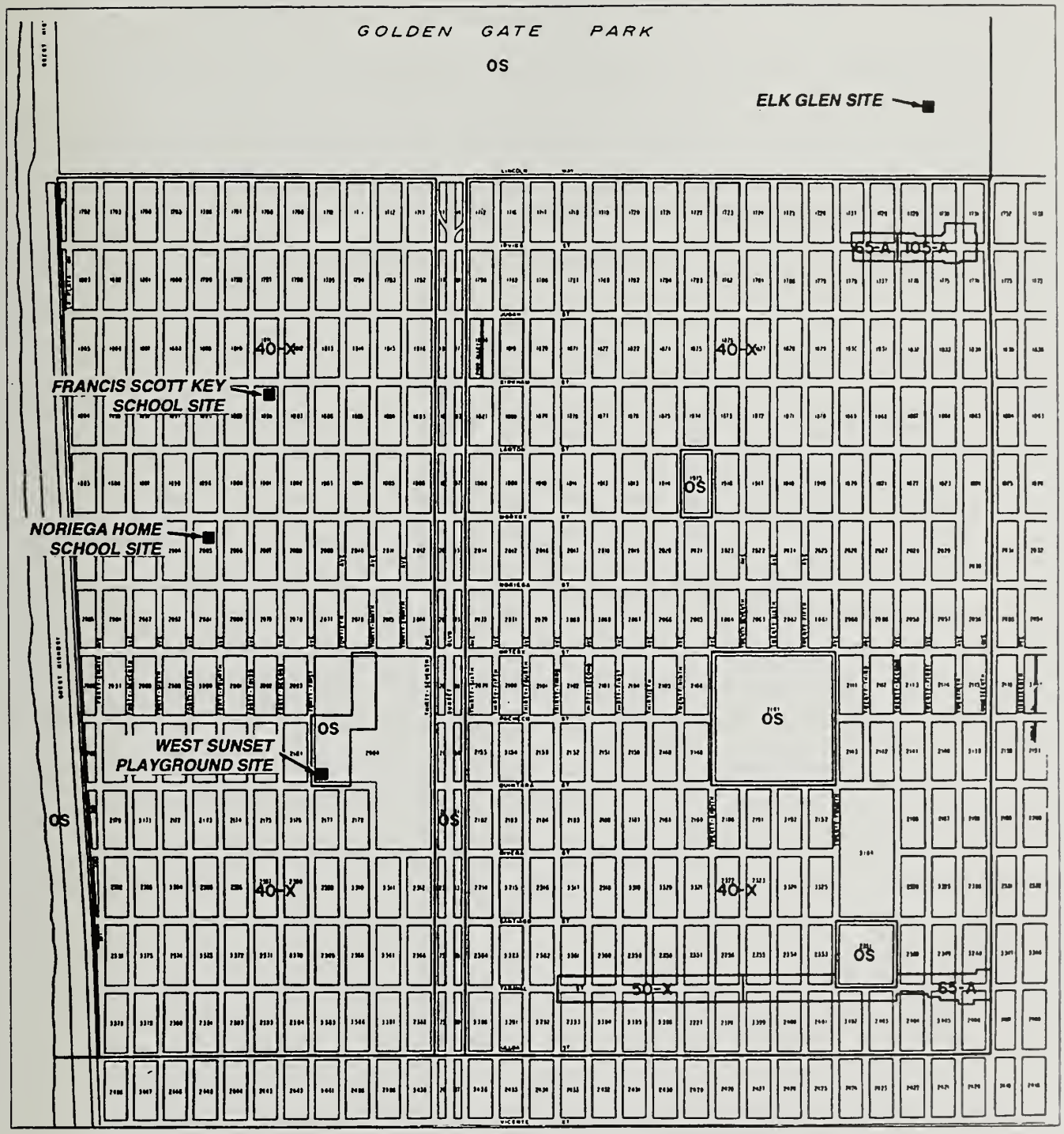
Figure 46
Elk Glen and Sunset Wells Sites–
Zoning Districts



SOURCE: City and County of San Francisco Municipal Code, Planning Department, Zoning Maps, 1990

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Figure 47
Elk Glen and Sunset Wells Sites–
Height and Bulk Districts

Visual Setting

The well site is immediately adjacent to (five to ten feet from) the lake path and is twenty-five to thirty feet from the lake. People walking on the path currently have a proximate, unobstructed view of the existing pump and chain link enclosure on the well site. Pampas grass and shrubs lie between the path and the lake in the area adjacent to the site, partially obscuring views of the site from other portions of the lake perimeter.

Sunset District Wells

Existing Land Use and Zoning

The proposed sites are located at Francis Scott Key School and West Sunset Playground, on Kirkham and Quintara roads, respectively. The existing on-site land uses at the Sunset District Well sites are school and playground uses, and the surrounding uses are residential and neighborhood commercial.

Francis Scott Key School is bounded by 42nd and 43rd Avenues and Kirkham and Lawton Streets (see Figure 45, p. 141). The proposed well and chlorination station would be located in the northeast corner of the school's playground, the narrower corner of the playground, about 100 feet by 100 feet. The remainder of the playground is approximately 200 feet wide by 500 feet long (a total of approximately 90,000 square feet). The playground is entirely paved, and surrounded by a ten-foot chain link and cement fence along 42nd Avenue and part of Kirkham Street. The playground is flanked by the school buildings to the west, and by residential development to the south. A wooden bench lines the fence inside the playground. The playground is the school's only playground and is used for lunch and recess play. In the corner of the playground proposed for the well site, there are two basketball hoops and a flagpole.

Two-story single family homes surround the school on all sides. Mixed commercial and residential uses line 42nd Avenue and Lawton Street one block to the south.

The West Sunset Playground site is located at 41st Avenue and Quintara Street, in a parking lot on the southwest corner of the West Sunset Playground complex (see Figure 45, p. 141). The West Sunset Playground is a ten square block area of schools, playgrounds and playing fields, between Sunset Boulevard and 41st Avenue and Ortega and Rivera streets. There is an existing water sampling test well adjacent to the proposed site, capped at grade in the parking lot.

The parking lot is a paved rectangular lot 70 feet wide and 335 feet long (about 23,450 square feet). The lot contains spaces for about 45 cars, and is used by school and playground employees and visitors. A line of 16 mature Monterey cypress trees and a cement wall topped by a chain link fence separate the parking lot from the bleachers and baseball fields north of the site. Adjacent to the site on the west and south are the residences on 41st Avenue and Quintara Street, 100 to 150 feet from the site. A soccer field is above the opposite end of the parking lot, about 300 feet east of the site.

The surrounding neighborhood is entirely residential, except for the public facilities in the West Sunset Playground. Other facilities within the ten-block West Sunset Playground complex include the Sunset Health Care Center, north of the baseball fields on 41st Avenue, and John O'Connell High School and J.P. Giannini Middle School on Ortega Street on the far north end of the playground.

Both of the Sunset Well sites are zoned P, Public District, and are surrounded by RH-1, Residential House, One Family District. Areas zoned NC-1, Neighborhood Commercial Cluster District lie immediately south of the Francis Scott Key site. The Francis Scott Key site and surrounding area is designated 40-X, and the West Sunset Playground site is designated OS, Open Space. See Figures 46 and 47 (p. 143 and p. 144) for Zoning and Height and Bulk Designations for these well sites.

There is no specific planning document relevant to the Sunset Well sites.

Visual Setting

Unobstructed views of the Francis Scott Key School well site are available through the chain link fence from the sidewalks and homes on 42nd Avenue and Kirkham Street, as well as from the playground. Unobstructed views of the West Sunset Playground well site are available from the sidewalks and homes along Quintara Street and 41st Avenue, as well as from the remainder of the parking lot. This site is not visible from the adjacent baseball fields.

Powell Street BART Station Dewatering System

Existing Land Use and Zoning

The existing dewatering system lies underground at the Powell Street BART station, at the corner of Market Street and Powell Street in the downtown area of San Francisco. Existing

surrounding land uses are high-rise business and transportation. The site is within C-3-R and C-3-G Districts (Downtown Retail and Downtown General Commercial, respectively).

Visual Setting

The valve vault site and staging area are visible from the Powell Street entrance and escalators. The remainder of the facilities are within areas of the station not open to the public and therefore not visible to the public.

Well Pipelines

Existing Land Use

Pipelines for the Elk Glen Well would run from the site through paved roads and soft surface paths to an existing water main about 120 feet away on Transverse Drive. Pipelines for the Sunset Well sites would be constructed in City streets from the sites to existing water mains on 28th Avenue or 30th Avenue. The streets along these routes are flanked mainly by residential uses, with some public facilities (schools) and mixed residential / commercial areas. The pipeline for the connection of the Powell Street BART dewatering facility to the AWSS would run through Downtown retail and commercial areas.

B. GROUNDWATER AND SURFACE WATER RESOURCES

This section presents a description of the existing groundwater and surface water conditions in San Francisco. It focuses on the groundwater basins with the most potential for future development and those surface water features hydrologically connected to those groundwater basins. The description includes a brief overview of hydrogeologic terms and concepts, followed by the physical setting, hydrologic characteristics, and development and management considerations for each groundwater basin. Site-specific groundwater information is also presented for proposed project sites.

Information in this section regarding existing conditions is based largely on a technical memorandum on Groundwater Resources prepared by CH2M Hill in 1993.[1] The groundwater information presented in that report is based on best available data on subsurface geologic conditions, well records, and groundwater pumping records. Additional groundwater information was developed in subsequent technical memoranda that employed predictive models on subsidence, saltwater intrusion, and Lake Merced.[2] Quantitative estimates, in particular, depict the current understanding or approximation of the groundwater resources in San Francisco, and are subject to change as additional groundwater data are collected as part of this project and other projects.

BASIC CONCEPTS OF GROUNDWATER HYDROLOGY[3]

Groundwater is a major natural resource. It is present in the ground in varying quantities depending on the availability of water and the type of underground or subsurface material. It can occur in the spaces or pores between soil particles (such as sand or gravel) or in the fractures in rock. In most cases, the area immediately beneath the ground surface contains a combination of air and water in the open spaces of the subsurface material; this is referred to as the unsaturated zone. Beneath the unsaturated zone, water entirely fills the open spaces of the subsurface material and is called the saturated zone. The interface between the unsaturated and saturated zones is the water table. Water within the saturated zone is referred to as groundwater. Figure 48 shows the relationship between these areas.

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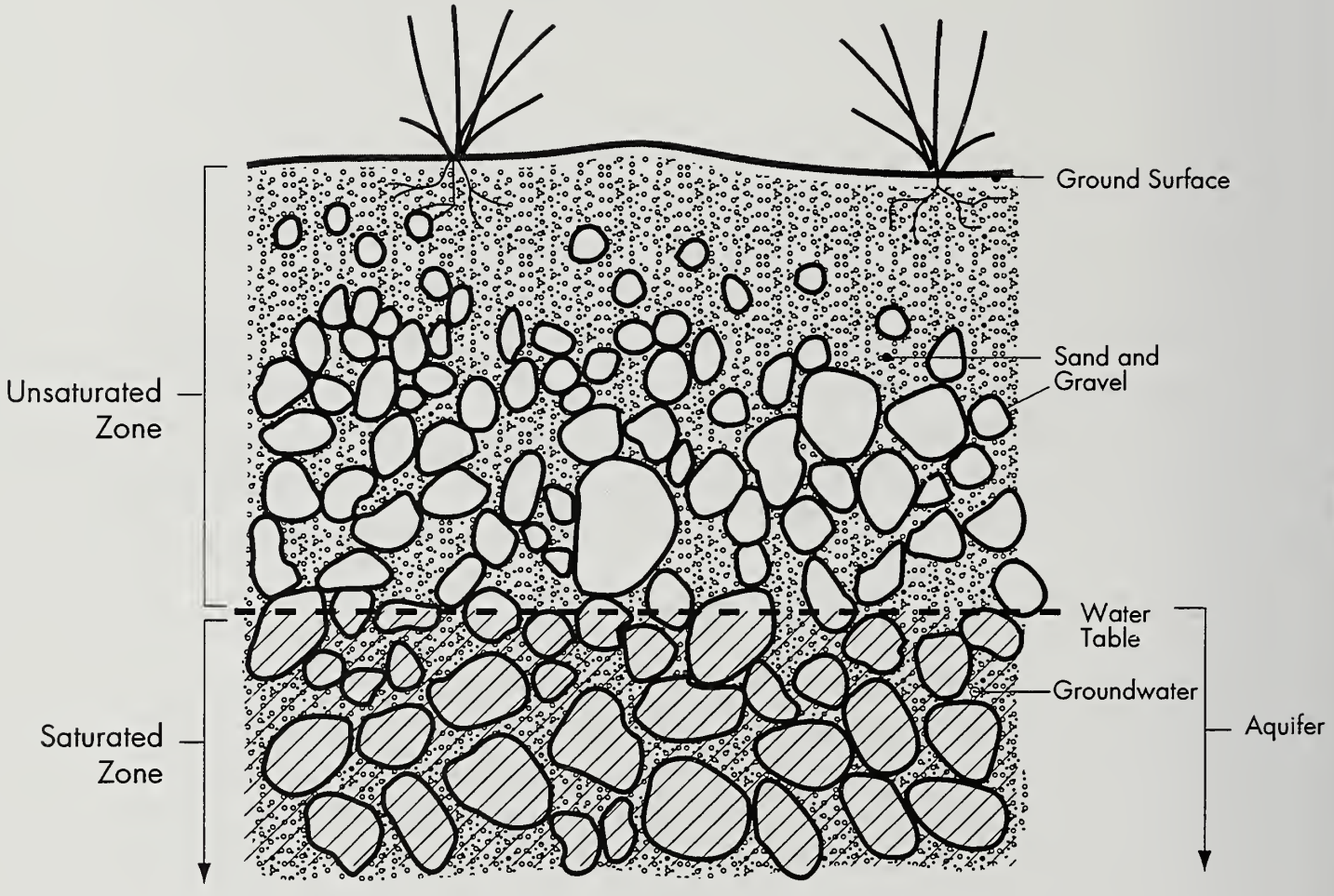
1 CH2M Hill/AGS, Inc., *San Francisco Groundwater Master Plan, Technical Memorandum 4, Groundwater Resources*, June 23, 1993.

2 CH2M Hill/AGS, Inc., *San Francisco Groundwater Master Plan*; Technical Memorandum 11, Subsidence Modeling of Westside and Lobos Basins, March 1994; Technical Memorandum 14, Preliminary Saltwater intrusion Evaluation, April 1995; and Technical Memorandum 15, Documentation of Lake Merced Model, April 1995.

3 Heath, Ralph C, 1983. *Basic Ground-Water Hydrology*. U.S. Geological Survey Water-Supply Paper 2220.



SOURCE: CH2MHill, 1995

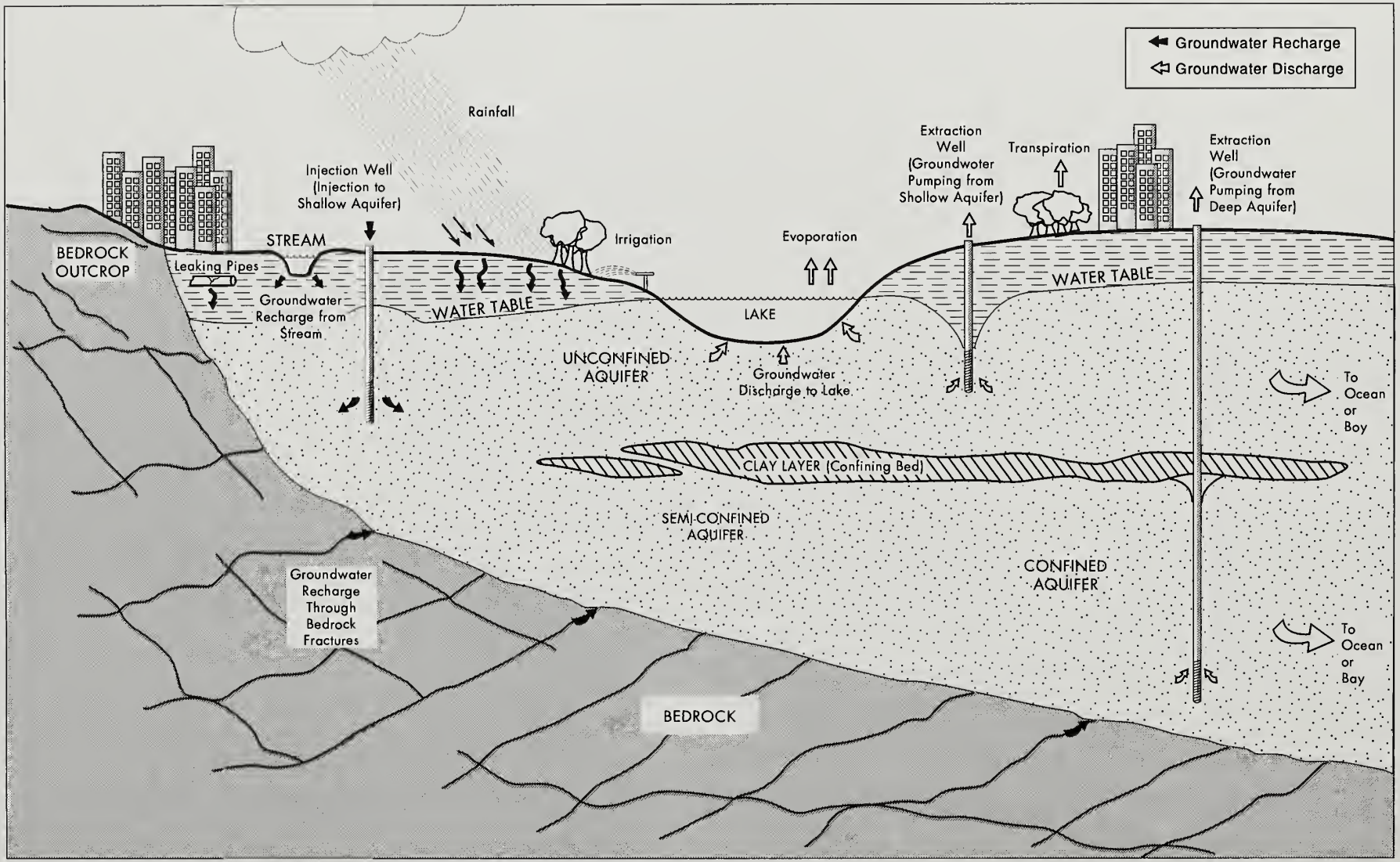
SF RWMP / GWMP Program EIR ■

Figure 48
Schematic of Groundwater Zones

If the water in the saturated zone is sufficient to supply groundwater wells or be the source of a spring, then the zone is called an aquifer. When water is withdrawn from a well or spring, not all of the water can be extracted due to the interaction between the subsurface material and the water. The portion of water stored in an aquifer that will drain under the influence of gravity and is available to supply groundwater wells is called specific yield.

The quantity, movement, and quality of groundwater is influenced by many factors. The quantity of groundwater present in the subsurface is determined by the balance of how much water enters and exits the groundwater system. Water entering the groundwater system is groundwater recharge, while water exiting the groundwater system is groundwater discharge. Sources of recharge water include rainfall, irrigation, leaking underground pipes, injected water, and surface water. Surface water is water on the ground surface, such as lakes and streams. Natural recharge occurs when surface water or rainfall infiltrates into the ground, percolates through the unsaturated zone and enters the saturated zone, primarily drawn down by the force of gravity. Recharge in urban areas such as San Francisco is affected by the amount of impervious surfaces (such as asphalt, concrete and buildings) which inhibits the natural recharge of the groundwater system. The amount of recharge in various parts of San Francisco can be estimated and takes into account factors associated with climate, land use, water use, irrigation, underground pipe leakage, rainfall runoff, and evapotranspiration. Groundwater discharge occurs through several mechanisms, including lateral movement within the saturated zone to sites such as seeps, springs, lakes, the ocean or bay, and groundwater pumping. Figure 49 is a schematic diagram of a groundwater system showing recharge to and discharge from the system.

Like surface water, water in the subsurface flows, although the rate of movement is generally slower than for surface water. Water in the unsaturated zone and the saturated zone can move as slowly as inches per year or as quickly as feet per day. The rate of movement of groundwater is influenced primarily by the type of material the water is passing through; water will move more quickly through sand or gravel than through clay or bedrock because the pore spaces between sand and gravel are larger. Materials such as clay and bedrock with low permeability often serve as defining boundaries for an aquifer and are referred to as confining beds or confining layers. The rate of groundwater movement is also affected by how much water is being added to and withdrawn from the system. For example, if groundwater is being actively pumped and extracted through wells, the groundwater will move more quickly near the well.



SOURCE: Orion Environmental Associates and CH2MHill, 1995

Figure 49
Schematic of Groundwater System

Groundwater movement is also influenced by the areal extent of the aquifer. In San Francisco, the aquifers occur as distinct groundwater basins. These are areas of permeable materials separated by bedrock ridges. The bedrock ridges often occur as the hills found throughout San Francisco (bedrock outcrops), but some bedrock ridges are covered by unsaturated sediments. The permeable sediments have been designated with formal and informal names in the San Francisco area. For example, in the Westside Basin, the dune sands, the Colma Formation, and the Merced Formation are variable in their extent and in the type of sediments that occur within each one. In both the Colma and Merced Formations, lenses of clay and silt may occur, which locally restrict the movement of water. Groundwater can still flow through these lenses, but usually at a much slower rate. These clay lenses then separate a larger aquifer into a shallow unconfined aquifer (open to atmospheric conditions) and a deep confined aquifer (overlain by a confining clay layer), as shown in Figure 49.

The groundwater system of an area includes the aquifer and confining beds as well as the recharge and discharge areas. The discharge areas could include streams or floodplains. In San Francisco, Lobos Creek, for example, is thought to be entirely fed by groundwater seepage. Lake Merced is thought to be a surface exposure of groundwater flowing through a shallow aquifer system. Thus, surface and groundwater systems are often directly inter-connected.

The development of groundwater through construction of water wells affects the movement of water in a groundwater system as well as the discharge and recharge rates and the specific yield. Groundwater withdrawal through well pumping or groundwater recharge through injection wells affects the natural storage in an aquifer and the discharge and recharge rates. Excessive pumping can lead to a number of groundwater management problems, such as (1) long-term reduction in specific yield of an aquifer, (2) compression of geologic material leading to subsidence of the ground surface above an aquifer, or (3) contamination of the groundwater quality either through inducing saltwater encroachment from an adjacent water-bearing zone or through inducing movement of chemical pollutants present in the soil or groundwater. If groundwater pumping results in discharge rates exceeding recharge rates, the condition of the aquifer is referred to as groundwater overdraft.

In addition to issues associated with groundwater yield and quantity, information on groundwater quality is important for understanding groundwater systems and for determining the suitability for any proposed uses. Groundwater quality depends on the types and amount of substances dissolved in the water, and is affected by natural sources, such as various soil and rock materials,

as well as by human activities, such as leaking sewers or underground tanks or percolation of lawn fertilizers or pesticides. If groundwater is developed for potable uses, then the groundwater quality must meet Drinking Water Standards and groundwater may require treatment before it is provided to the public.

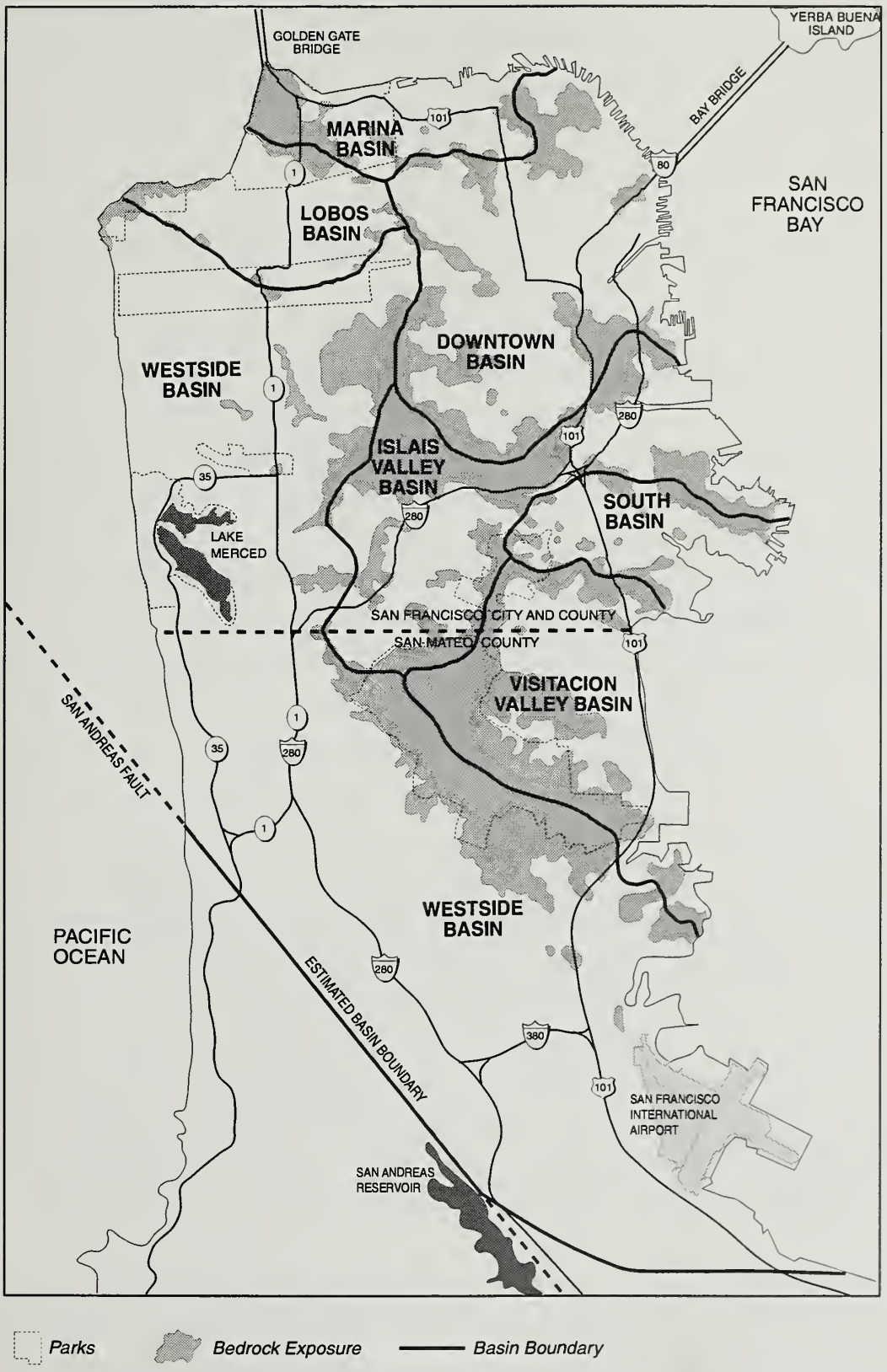
In many urban areas, current and previous land uses have involved the use and handling of hazardous materials, which, if improperly handled, can result in contamination of underlying soil and groundwater. In San Francisco, the locations and conditions of many of these sites have been identified and are listed on regulatory agency databases. The hazardous waste contamination sites may or may not affect the groundwater quality, depending on the nature and extent of the contamination and if the contamination extends into or is moving towards an area of potential groundwater development. Groundwater clean-up or remediation at these sites is under the jurisdiction of the California Regional Water Quality Control Board.

The management of groundwater resources involves extensive geologic, hydrologic and chemical investigations to determine both the short-term and long-term effects of development on the entire groundwater system. Comprehensive understanding of baseline conditions affecting groundwater systems as well as continuous changes to the system associated with groundwater pumping, weather conditions, surface water development, and other factors are necessary for sound groundwater management.

GROUNDWATER AND SURFACE WATER OVERVIEW

There are seven groundwater basins underlying San Francisco: the Westside, Downtown, Lobos, Marina, Islais Valley, South, and Visitacion Valley basins. The Downtown, Lobos, Marina, and South basins are wholly contained within San Francisco. The Westside, Islais Valley, and Visitacion Valley basins are located in both San Francisco and in San Mateo County, with the Westside Basin extending further south along the east side of the peninsula to south San Francisco Bay as part of a regional groundwater system.

Available information on the different groundwater basins varies, depending on historical records and the extent and types of studies conducted to date on each basin. This report summarizes the best available information, although it is likely that more information will be required as the proposed GWMP proceeds into the future. The general locations of the groundwater basins relative to the exposed bedrock are shown in Figure 50, and the general characteristics of each of the basins are shown in Table 10 (p. 79). For each basin, the table presents estimated average



SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

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Figure 50
Groundwater Basins Within and Adjacent to the City and County of San Francisco

annual rate of recharge, current (1993) annual rate of extraction, likely groundwater quality, and an indication of development potential. As indicated in the table and discussed in further detail below, the development of groundwater resources has the highest potential to occur within the Westside, Downtown and Lobos basins.

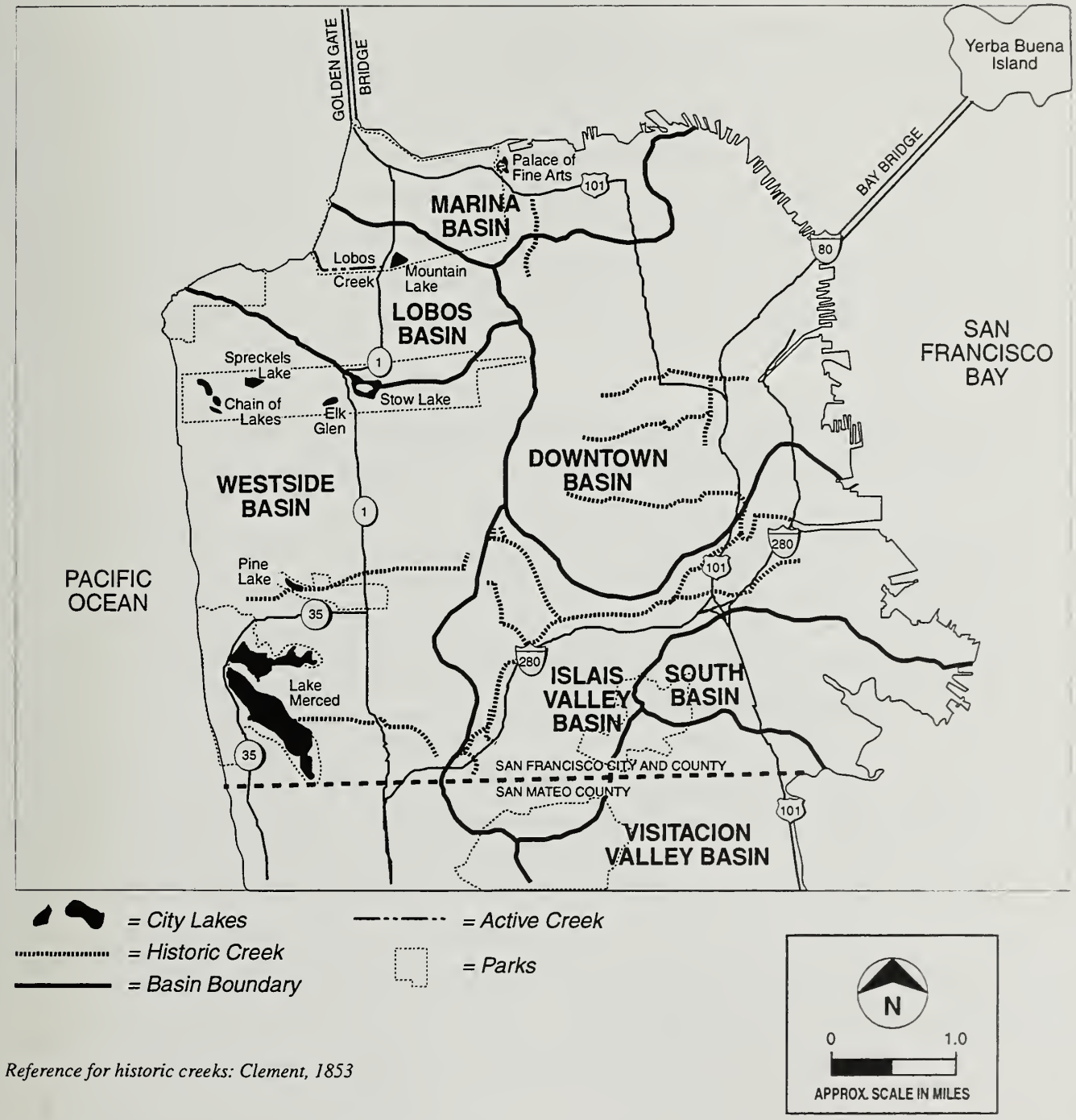
Historically, the City had numerous streams and creeks that provided natural drainage from hills and valleys of the City to the Bay or ocean, but with the settlement and development of the City, all of the creeks and stream beds, with the exception of Lobos Creek, were filled or paved. Essentially all surface drainage in the City has been channelized through the combined stormwater/sewage system. The two major surface water features associated with potential groundwater development are Lake Merced, located in the Westside Basin, and Lobos Creek, located in the Lobos Basin. Both Lake Merced and Lobos Creek are hydrologically connected to the groundwater systems, and have been identified as either existing or potential drinking water sources. Mountain Lake, located in the Lobos Basin, historically served as a drinking water source, may be hydrologically connected to the groundwater system, although it is not well understood, as discussed below. Figure 51 presents a schematic of the lakes and historic streams in the City.

Westside Basin and Lake Merced

Basin Characteristics

Hydrologic Setting. The Westside Basin is the largest of the seven basins in the City and County of San Francisco, with an areal extent of about 24,500 acres. Approximately 9,500 acres of the Westside Basin lie within San Francisco and 15,000 acres lie within San Mateo County (see Figure 50, p. 154). The Westside Basin is bounded on the north by a northwest trending bedrock ridge through the northeastern area of Golden Gate Park, and on the east by a bedrock ridge whose high points include Twin Peaks, Mount Sutro, Mount Davidson and the San Bruno Mountains. The western border of the basin is the San Andreas Fault and the southern border is generally the southern extent of the Colma Formation, south of the City of San Bruno.

The thickness of the aquifer varies throughout the Westside Basin. In the northern portion of the basin, adjacent to Golden Gate Park, the maximum depth to bedrock is approximately 500 feet, while south of the County line the maximum depth to bedrock is approximately 3,500 feet. The water bearing sediments in Westside Basin are the Merced Formation overlain by the Colma Formation overlain by dune sands. The Merced Formation sediments range in thickness from 0 to



Reference for historic creeks: Clement, 1853

SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

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Figure 51
Location of Lakes and Creeks in San Francisco

3,000 feet, the Colma Formation thickness ranges from 0 to 300 feet, and the dune sands overlying the Colma Formation north of Lake Merced ranges from 0 to 80 feet thick. Groundwater production in Daly City and San Bruno is mainly from the Merced Formation.

South of the San Francisco Zoo, discontinuous clay layers have been found at depths, which inhibit vertical groundwater movement and form a confining layer. This results in a two-aquifer system in this area, with a shallow and a deep aquifer. Where the clay layer is thick and continuous, the deep aquifer is confined, but where the clay layer thins out and becomes discontinuous, the deep aquifer becomes semi-confined or unconfined. Recharge to the deep aquifer is thought to occur by vertical percolation in those areas where the clay layer becomes discontinuous. North of the Zoo, through the Sunset District and Golden Gate Park, the aquifer may exhibit a variety of characteristics and may be confined, semi-confined or unconfined at various places.[4]

Groundwater movement in the portion of the basin underlying the City is generally westward towards the Pacific Ocean, although south of Lake Merced, groundwater movement is southward, towards areas of groundwater pumping at nearby golf courses and at locations south of the County line. Near Lake Merced, there has also been evidence of long-term declines in groundwater level, as discussed below, as the recent drought and pumping of groundwater appears to have affected groundwater levels. Studies have indicated that some seawater intrusion may occur in the Westside Basin south of Lake Merced, although there has been no observed effect on groundwater quality from the deep aquifer.[5]

Table 14 summarizes general groundwater characteristics for the northern and southern portions of the Westside Basin. The northern portion of the basin (within City corporate boundaries) makes up approximately 40% of the total basin land surface area, approximately 33% of the recharge area for the Westside Basin, and less than 20% of the discharge volume for the entire basin. The southern portion of the basin, south of the county line, makes up approximately 60% of the total basin land surface area, approximately 67% of the basin's recharge area, and more than 80% of the total basin's discharge volume.

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4 CH2M Hill/AGS, Inc., *San Francisco Groundwater Master Plan, Technical Memorandum 4, Groundwater Resources*, June 23, 1993.

5 Geo/Resource Consultants, Inc., Draft Report, *Lake Merced Water Resource Planning Study, San Francisco, California*, May, 1993.

TABLE 14: WESTSIDE GROUNDWATER BASIN CHARACTERISTICS

	Westside Basin, northern part	Westside Basin, southern part	Total Westside Basin
DEPTH TO BEDROCK (feet)	500	3,500	500 - 3,500
SURFACE AREA (acres)	9,500	15,000	24,500
RECHARGE (ac-ft/yr) /a/	4,800	10,000	14,800
DISCHARGE (ac-ft/yr) /b/	~2,500	~11,300	13,800
WATER QUALITY	potable	potable	potable

/a/ Natural recharge is calculated based on data from the 1987-1992 drought period and accounts for factors associated with climate, land use, water use, irrigation, underground pipe leakage, rainfall runoff, and evapotranspiration. Recharge in Northern Basin from Technical Memorandum 4, CH2M Hill, 1993. Recharge in Southern Basin from Applied Consultants, 1991.

/b/ Discharge estimates include pumping extraction, evapotranspiration and outflow to the Pacific Ocean. Pumping in the Westside Basin varies depending on rainfall and seasonal irrigation of parks, golf courses and cemeteries (Technical Memorandum 4, CH2M HILL, 1993 and GWMP Table 2-2, Section 2), and estimates may be low because pumping records are incomplete. In the northern portion of the Westside Basin, groundwater is pumped at Golden Gate Park, the SF Zoo, and golf courses near Lake Merced (GWMP, Section 7). The currently estimated sustainable pumping for the northern portion of the basin is 2,250 ac-ft/yr. In the southern portion of the Westside Basin, groundwater is pumped for irrigation and municipal water supply. Previously estimated overdraft in the southern portion of the Westside Basin is 800 ac-ft/yr (Applied Consultants , 1991).

SOURCE: Environmental Science Associates, 1995, based on CH2M Hill, 1993. Technical Memorandum 4, Groundwater Resources; and City and County of San Francisco, Groundwater Master Plan, Draft, July 1996.

Basin Recharge. Annual total recharge of the Westside Basin is estimated to be approximately 14,800 acre-feet per year (ac-ft/yr) (see Table 10, p. 79), with about 4,800 ac-ft/yr occurring within San Francisco and 10,000 ac-ft/yr occurring within San Mateo County.

Basin Discharge. Groundwater discharge in the Westside Basin includes removal by pumping, evapotranspiration, and outflow to the Pacific Ocean. Total discharge from the Westside Basin is estimated to be about 13,800 ac-ft/yr (see Table 10, p. 79), with about 2,500 ac-ft/yr occurring

in San Francisco and about 11,300 ac-ft/yr occurring south of the County line. The main current uses of groundwater pumped from the Westside Basin are municipal and irrigation uses, as described in Table 15 and discussed below. As shown in Table 15, a total of approximately 12,000 ac-ft/yr of basin discharge is attributed to groundwater pumping, with about 90% of that amount occurring in the southern portion of the basin. The remaining discharge includes evapotranspiration which occurs primarily at Lake Merced and outflow into the Pacific Ocean near Golden Gate Park and the Sunset District.

Water Balance. Based on the estimates presented above, the water balance for groundwater flows in the Westside Basin varies for the northern and southern portions of the basin. North of Lake Merced, the estimated recharge rate exceeds the discharge rate, indicating that there is a net movement of groundwater flowing toward the ocean. South of Lake Merced, however, the estimated discharge rate appears to exceed the recharge rate, resulting in a southward and downward gradient of groundwater flow. As discussed below, the increased discharge rate south of the County line is associated with the groundwater pumping for irrigation and municipal water supply uses. This increased discharge rate in the southern part of the basin has resulted in localized overdraft conditions and lowering of water levels in Lake Merced, as described further below under *Lake Merced*.

Existing Wells. As shown in Table 15, existing production wells in the Westside Basin are used primarily for irrigation and recreation uses in San Francisco and for irrigation and municipal water supply in the southern portion of the basin. Within San Francisco, there are irrigation wells in Golden Gate Park, the Zoo, private golf courses, Lake Merced, and Stern Grove which in general draw groundwater from more than 100 feet below the ground surface. There are also a number of observation wells throughout the basin, particularly in the vicinity of Lake Merced and along the shoreline between Golden Gate Park and the Zoo. Municipal uses in the southern portion of the basin, including Daly City, Cal Water Service and San Bruno, pump groundwater from the deep aquifer and account for more than half of the total estimated pumping in the Westside Basin. Irrigation uses in the southern portion of the basin include golf courses, cemeteries and nursery uses.

At the proposed project sites for the GWMP, there is an existing irrigation well at the Elk Glen site and a test well at the West Sunset Playground site. The Elk Glen Well is located on the northeast side of Elk Glen Lake in Golden Gate Park, near the intersection of Middle Drive West and Transverse Drive (see Figure 30, p. 98). The well is approximately 360 feet deep

TABLE 15: ESTIMATED GROUNDWATER PUMPING BY TYPE OF USE, WESTSIDE BASIN, ABOUT 1991

	Million Gallons/Year	Acre-Feet/Year
Municipal Uses /a/	2,236	6,861
Golf Course Irrigation Use /b/	525	1,612
Cemetery and Nursery Use /c/	665	2,041
Recreation and Park Uses /d/	476	1,459
TOTAL	3,902	11,973

/a/ Municipal uses include Daly City, Cal Water Service and San Bruno.
/b/ Golf course irrigation uses include Olympic Club, San Francisco, Lake Merced, California and Cypress Hills.
/c/ Cemetery and nursery use include Wood Lawn, Italian, Olivet, Eternal Home, Home of Peace, Hills of Eternity, Cypress Lawn, Holy Cross and Golden Gate.
/d/ Recreation and park uses include Golden Gate Park, San Francisco Zoo, Lake Merced, Stern Grove, and Harding Park Golf Course.

SOURCE: Applied Consultants, 1991; Tom Salzano, Cal Water Service, 1993; and CH2M Hill/ AGS, Inc., 1993, Technical Memorandum 4, Groundwater Resources.

with the depth to groundwater about 60 to 70 feet below grade, and is currently used for irrigation at Golden Gate Park. Groundwater from the Elk Glen Well is generally of potable quality. The twelve-inch well is screened from 170 to 350 feet below grade, and currently has an estimated continuous pumping capacity of 1,300 ac-ft/yr. At the West Sunset Playground (see Figure 32, p. 102), a test well was drilled in the southwest corner of the playground in 1993. The test well was designed and constructed to be representative of a potential municipal well. The well has a casing diameter of six inches, is about 350 feet deep, and is screened from 150 to 330 feet below ground surface.[6]

Water Quality. Field investigations have been conducted to gather information on the groundwater quality of the Westside Basin.[7] Groundwater samples were taken in 1993 at nine existing wells throughout the basin and at a test well installed at the West Sunset Playground at

6 CH2M Hill/AGS, Inc., *Groundwater Master Plan Technical Memorandum 8, Westside Basin Field Investigation Program,* January 31, 1994.
7 ibid.

41st Avenue and Quintara Street in the Sunset District, for a total of ten samples. Because high-capacity wells are currently producing high-quality water throughout the Westside Basin (both northern and southern portions), groundwater in the Westside Basin is generally expected to be of potable quality. The results of preliminary groundwater sampling indicate that, although water quality varies across the basin, the Westside Basin groundwater generally meets Drinking Water Standards. During the 1993 sampling event, Drinking Water Standards for all constituents were met at seven of the ten wells sampled. At the remaining three wells, Drinking Water Standards were met for all but one constituent in each of the three wells. The one exception at these wells for this one sampling event were as follows: in the Stern Grove well, the concentration of coliform bacteria (a primary standard) exceeded the Drinking Water Standard, at the Oceanside well, the concentration of manganese (a secondary standard) exceeded the standard, and at the West Sunset Playground well, the concentration of iron (a secondary standard) exceeded the standard. Additional groundwater sampling to verify these results would be conducted if groundwater development for potable water is approved.

There are relatively few sites in the northern portion of the Westside Basin that have had known toxic releases, and identified sites are mostly gasoline stations. See Section IV.F., Hazardous Materials, at p. 204 below, for discussion of hazardous materials near sites proposed for groundwater development.

Lake Merced

Physical Setting. Lake Merced is a natural freshwater lake located in the southwestern corner of San Francisco separated from the Pacific Ocean by a 1,300-foot wide band of sand-covered hills. It is the City's largest lake with a total surface area of 273 acres and a volume of approximately 3,710 acre-feet (see Table 16). The lake receives no natural stream flow and has no surface outlet and is thus considered an exposure of groundwater flowing through a shallow aquifer system. Although the lake receives only minor amounts of stormflow or surface inflow (less than 1% of the total recharge in an average year and less than 7% of the total recharge in a 25-year storm event), it does not stagnate due to the rate of groundwater flow through the underlying sandy substrate. As a "groundwater outcrop", water levels in the lake serve as an indicator of groundwater status.

Historically, Lake Merced was a single lake with a direct connection to the Pacific Ocean, but in the last two centuries it has been separated from the ocean by a sand spit, except during a 30-year

TABLE 16: LAKE MERCED HYDROLOGICAL CHARACTERISTICS /a/

	North Lake	South Lake	Impound Lake	Total
GENERAL CHARACTERISTICS				
Total Lake Surface Area (acres) /b/	---	---	---	273
Total Volume (acre-feet) /b/	---	---	---	3,710
Maximum Depth (feet) /b/	24	23	12	---
Average Depth (feet) /b/	13	16	8	---
Spillway Elevation (feet msl)	---	20.1	---	---
Recharge Area (acres) /d/	---	---	---	3,100
SURFACE INFLOW				
Average Annual Rainfall (inches) /b/	---	---	---	21
Rainfall onto Lake (ac-ft/yr)	---	---	---	478
Average Annual Surface Runoff into Lake (ac-ft/yr) /c/	17.5	8.9	4	30
Average Surface Inflow/Total Recharge Ratio	0.7%	0.4%	0.2%	1.3%
5-year Stormflow Inflow (acre-feet) /c/	---	---	104	---
25-year Stormflow Inflow (acre-feet) /c/	---	---	163	---
25-year Stormflow Inflow/ Total Recharge Ratio	---	---	6.8%	---
GROUNDWATER INFLOW OR RECHARGE				
Leaking Sewer (ac-ft/yr) /b/	---	---	---	240
Groundwater Inflow (ac-ft/yr) /b/	---	---	---	1,040
Total Inflow or Recharge (ac-ft/year) /d/	---	---	---	**1,500 - 2,400**
GROUNDWATER OUTFLOW/DISCHARGE				
Pumping extraction (ac-ft/year)/e/	---	---	---	1,305 - 1,540
Evapotranspiration (ac-ft/year) /d/	---	---	---	125 - 400
Outflow to Ocean (ac-ft/year) /f/	---	---	---	-1,210 to 460
Total discharge (ac-ft/year) /g/	---	---	---	**1,890 - 1,940**

/a/ Groundwater budgets prepared by Geo/Resources, 1993 indicate that the data presented above are more representative of a dry year than of a wet or normal year since much of the baseline data was collected during the 1987 - 1992 drought period.

/b/ Yates et al., 1990. Lake water surface and capacity from Entrix, 1988; based on lake water level of 11.7 msl.

/c/ Geo/Resource Consultants, 1993, Section 2.2.4: assumes 18.2 acres of impervious surface in the drainage area.

/d/ Technical Memorandum No. 4, Table 1, CH2M Hill/AGS, Inc., June 1993; Yates et al., 1990. Values represent the range of reported estimates from various studies, not natural range of variation.

/e/ Groundwater Master Plan, Section 7; Technical Memorandum No. 4, Table 4-4. Values represent the range of reported estimates from various studies, not natural range of variation.

/f/ Geo/Resources, 1993, Table 6-1; Yates et al., 1990. Values represent the range of reported estimates from various studies, not natural range of variation.

/g/ Values represent a range of natural conditions based on reported values. The low value (1,890) represents wet years which assumes that the pumping rate is lowest (1,305), evapotranspiration is lowest (125), and ocean outflow is maximum (460), The high value (1,940) represents drought conditions when pumping rates are highest (1,540), evapotranspiration is highest (400) and ocean outflow is zero.

SOURCE: Environmental Science Associates, 1995.

period following an earthquake in 1852 when a channel formed connecting the two.[8] The lake is now divided into three sections: North Lake, South Lake, and Impound Lake. North Lake has two basins separated by a narrow strait; North and South Lakes are separated by a strip of land and are hydrologically connected by a gated culvert; while, South Lake and Impound Lake are separated by a three-compartment box sewer (see Figure 52). A spillway from South Lake into Impound Lake has an elevation of 20.1 feet mean sea level [NGVD 29] (msl). Maximum lake depth ranges from 24 feet at North Lake to 12 feet at Impound Lake.

Dune sands and unconsolidated sediments of the Colma and Merced formations comprise basin fill in the vicinity of Lake Merced. Depth to bedrock ranges from 400 feet to 1500 feet. A thick clay layer is found at a depth of 100 to 130 feet in the vicinity of Lake Merced, which ranges in thickness from 45 to 53 feet. This clay layer partly isolates the overlying shallow aquifer from the underlying confined part of the aquifer system, and data suggest that the shallow and deep aquifer are hydrologically connected.

Data from the southern end of Lake Merced show that surface water is recharging the deeper part of the aquifer system in this location.[9] However, more field data are needed in the Lake Merced area to understand the connection between the upper aquifer that contains the lake and the lower aquifer where groundwater extraction occurs. Figure 53 is a cross-section of the groundwater aquifer in the vicinity of Lake Merced, showing the shallow and deep aquifers and the intervening clay layer. The figure indicates that the relationship of Lake Merced to the water table in the surrounding aquifers varies in the northern and southern parts of the lake, which is likely due to different patterns of groundwater usage in different parts of the aquifer.

Hydrologic Characteristics. Hydrologic characteristics of Lake Merced, shown in Table 16 (p. 162), were described in large part in a recent study that included development and application of a groundwater model by Geo/Resources.[10] However, a longer record of data is needed that includes wet water years because the current baseline data tends to reflect drought conditions that occurred in the late 1980s and early 1990s.

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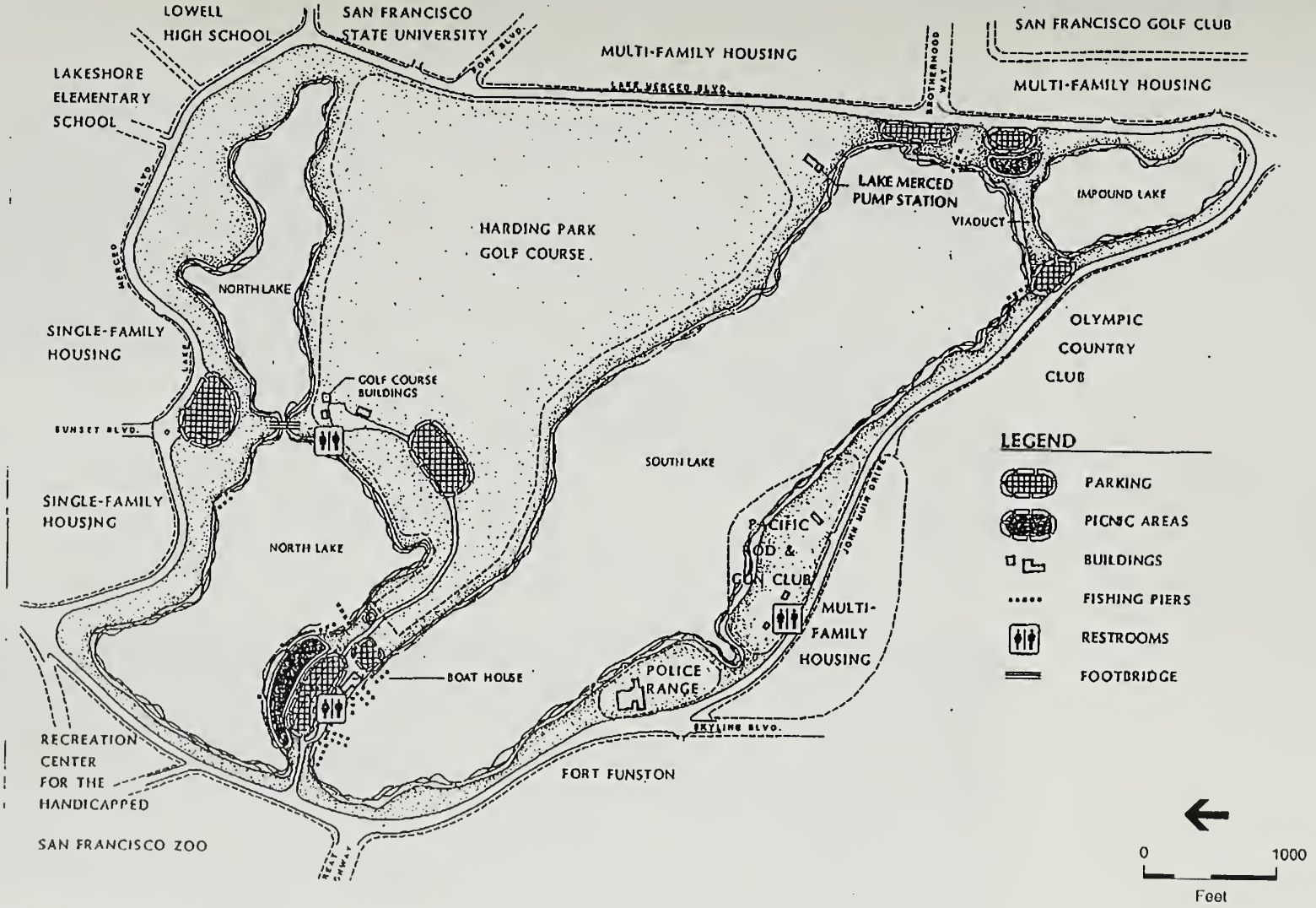
8 Geo/Resources Consultants, *Lake Merced Water Resource Planning Study*, prepared for San Francisco Water Department. May 1993.

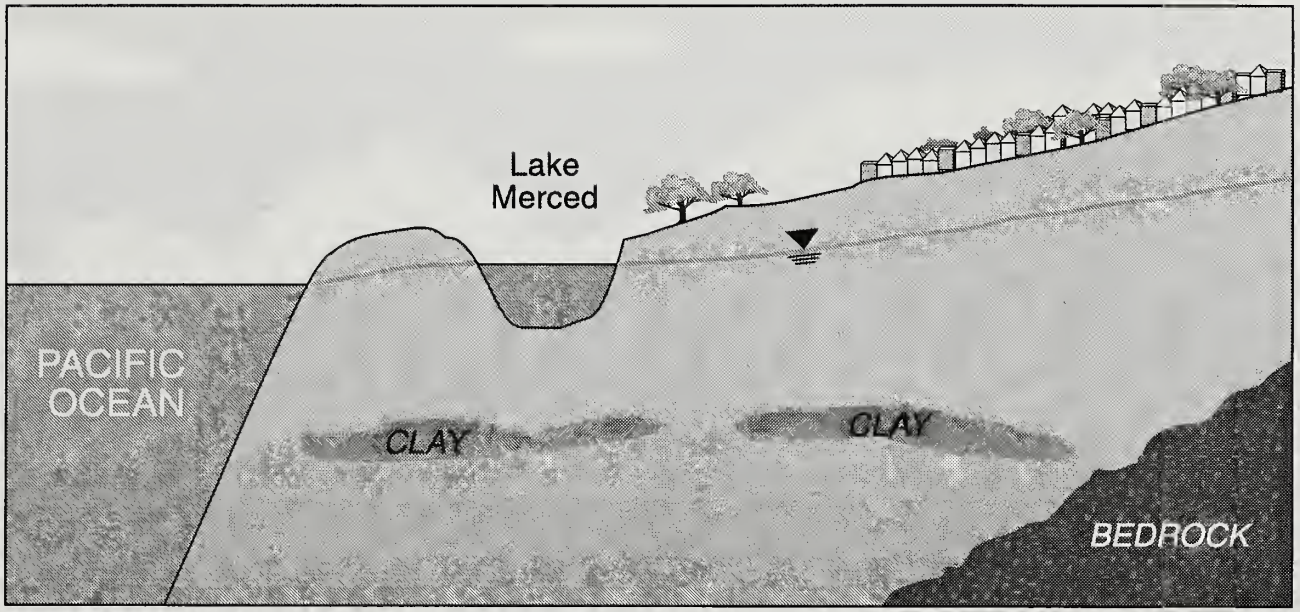
9 Yates, Eugene, Hamlin, Scott, and McCann, Lisa, *Geohydrology, Water Quality and Water Budgets of Golden Gate Park and the Lake Merced Area in the Western Part of San Francisco, California*, U.S. Geological Survey, Water-Resource Investigations Report 90-4080, 1990.

10 Geo/Resource Consultants, Inc., *Lake Merced Water Resource Planning Study*, prepared for San Francisco Water Department, May 1993.

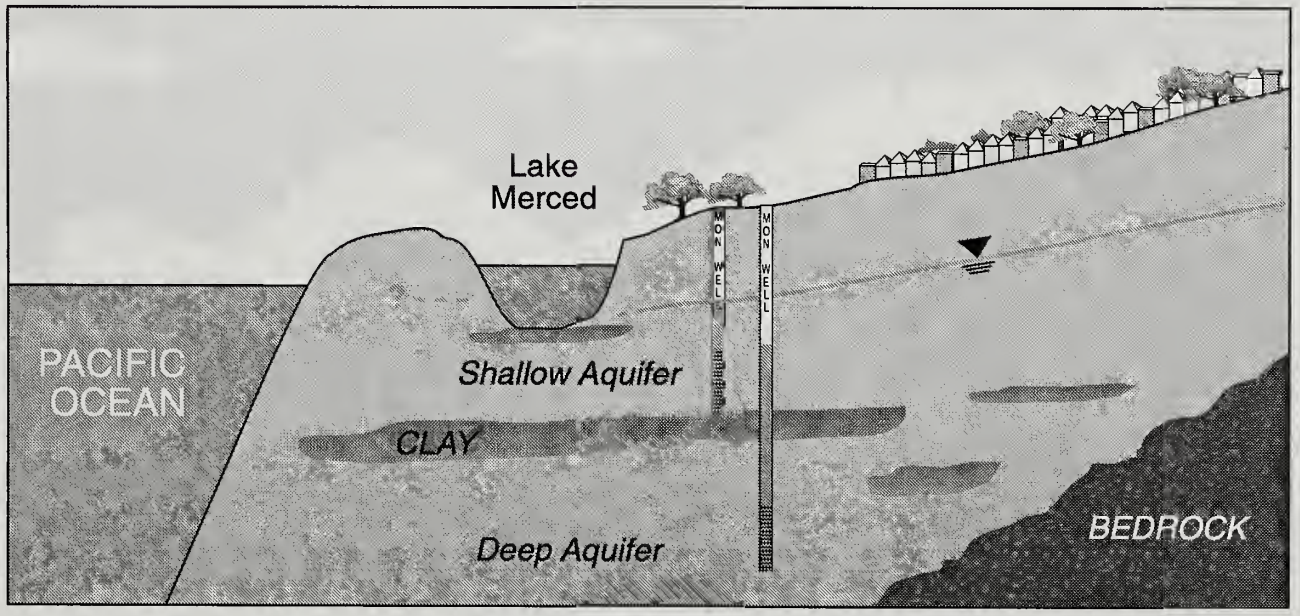


SOURCE: GeoResources Consultants, Inc., *Lake Merced Water Resource Planning Study*, prepared for San Francisco Water Department, May, 1993

Figure 52
Lake Merced and Surrounding Area



The Northern Portion of Lake Merced is an Expression of the Local Groundwater Table



The Southern Portion of Lake Merced is Several Feet Above the Local Groundwater Table

SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

Figure 53
Schematic Cross Section of Aquifer in Vicinity of Lake Merced

The area influencing the groundwater system in the vicinity of Lake Merced has been roughly modeled as the area bounded by the Pacific Ocean, 19th Avenue, Vicente Street, and John Daly Boulevard, although specific boundaries have not been defined. Estimates from various studies for the total inflow or recharge for the groundwater system in the Lake Merced area range from 1,500 to 2,400 ac-ft/yr. Estimates from various studies for groundwater pumping extraction in the Lake Merced area range from 1,305 to 1,540 ac-ft/yr, and estimates for total discharge in this area (includes pumping, evapotranspiration and outflow to the ocean) range from 1,890 to 1,940 ac-ft/yr.

Depending on the assumptions used to estimate recharge and discharge, the groundwater balance in the Lake Merced area may represent overdraft conditions. One reason for the discrepancies in reported discharge rates is that groundwater outflows to the Pacific Ocean are poorly understood throughout the basin. They are estimated to range from 0 to 1,000 ac-ft/yr near Golden Gate Park, 1,500 to 2,500 ac-ft/yr near the Sunset District, and anywhere from -1,210 to 460 ac-ft/yr near Lake Merced. The negative outflow of 1,210 ac-ft/yr in the Lake Merced area signifies that according to one model, the direction of groundwater flow is predicted to be reversed, flowing from the ocean toward land rather than as outflow to the ocean (this negative outflow does not necessarily imply an inflow of seawater to the Lake Merced area, since the freshwater lens in the aquifer extends beyond the shoreline). The assumptions used to estimate outflow were based on data collected during dry years, and groundwater in the Lake Merced area during this time has been identified to be in a state of overdraft.[11] The high percentage of the total discharge attributed to pumping indicates that groundwater development in this area has likely contributed to the overdraft conditions in this part of the groundwater system, including the declining Lake Merced water levels. The approximations used in the groundwater modeling efforts require additional field data and modeling to confirm the effects of groundwater pumping on lake levels and to verify the results of previous modeling efforts, discussed below. The declining water levels in Lake Merced and in deep wells south of the County line provide evidence of overdraft conditions in this part of the basin.

Lake Water Levels. Lake water levels have been recorded since 1935 at the Lake Merced Pumphouse, located at the eastern end of South Lake. Minimum annual lake levels from 1935 to 1986 and mean daily lake levels from 1987 to 1994 are graphed on Figure 54. Water levels in

[11] Yates, Eugene, Hamlin, Scott, and McCann, Lisa, *Geohydrology, Water Quality and Water Budgets of Golden Gate Park and the Lake Merced Area in the Western Part of San Francisco, California*, U.S. Geological Survey, Water-Resource Investigations Report 90-4080, 1990.

the lake were relatively stable for 20 years between 1941 to 1961, averaging approximately 19 feet above mean sea level (msl) (as indicated on the 1956 USGS San Francisco South quad). In 1962, water level dropped to 14 feet msl but then remained relatively stable for the next 13 years. Following a severe drought in the mid-1970s, lake levels began to decline at a rate of 0.3 feet per year, prompting the City, in 1978, to add 400 million gallons of municipal water to the lake. The water addition temporarily increased water levels but did not alter the general rate of water level decline. Between 1986 and 1993, another period of prolonged drought occurred in which the decline in lake levels accelerated, resulting in an average loss of 1.3 feet per year to reach a low of 5 feet msl in 1992.

Rapidly dropping lake levels in the last six years are directly related to drought conditions; however, longer term declines in Lake Merced water levels are indicative of overdraft conditions in the groundwater table. Groundwater elevations in the deep wells at the Olympic Club and San Francisco Golf Club range between 30 to 80 feet below sea level, thus creating a steep, downward hydraulic gradient. Stable isotope data and concentrations of chloride and nitrate indicate that surface water from Lake Merced is recharging the deep aquifer system south of the lake.[12] South of Lake Merced, water levels in the Daly City municipal wells have declined at a rate of 4.2 feet per year during the period 1940 to 1970, dropping from 10 feet above sea level to 115 feet below sea level. Since 1970 there has been little net decline in the deep part of the aquifer system in the southern portion of the Westside Basin.[13] Pumping by Daly City, San Bruno, the California Water Service and nine cemeteries in Colma totals approximately 8,900 ac-ft/yr, see Table 15 (p. 160).

Geo/Resources[14] modeled the effect of eliminating local golf course pumping on the lake level from 1949 to 1990 by simulating the groundwater system without those wells. Model results indicated that lake levels would have been approximately 4 to 5 feet higher than historically recorded levels if groundwater pumping for irrigation at local golf courses had been discontinued. The effect of reducing pumping by 1 mgd in Daly City municipal wells was also modeled for the same period, and results indicated that lake levels would have been approximately 10 feet higher than historically recorded levels. Per unit of pumpage, the local wells closer to the lake had a larger effect on predicted lake level than the distant wells. From

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12 Yates, Eugene, Hamlin, Scott, and McCann, Lisa, *Geohydrology, Water Quality and Water Budgets of Golden Gate Park and the Lake Merced Area in the Western Part of San Francisco, California*, U.S. Geological Survey, Water-Resource Investigations Report 90-4080, 1990.

13 ibid.

14 Geo/Resource Consultants, Inc., *Lake Merced Water Resources Planning Study*, prepared for San Francisco Water Department, May 1993.

NOTE: Drought period contains years classified as below normal, dry, or critically dry according to the Department of Water Resources
SOURCE: USGS Mean daily records from Recorder 11162680 Lake Merced at Pumphouse

SOURCE: City and County of San Francisco, *Groundwater Master Plan*, Draft, July 1996

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Figure 54
Lake Merced Water Level and Recharge Effects

monitoring data and groundwater modeling, it can be concluded that long-term water level decline in Lake Merced is most likely due to pumping in the deep aquifer and that drought conditions have exacerbated lake conditions by reducing recharge.

Although the Westside Basin south of Lake Merced appears to be in a state of overdraft, as indicated by the long-term decline in lake levels and the occurrence of water levels below sea levels, there is no evidence of saltwater intrusion in the production wells near Lake Merced.

Water Quality. The SFWD conducts weekly monitoring of water quality in North Lake and South Lake for pH, alkalinity, chloride, hardness, turbidity, color, conductivity and total coliform. Water quality characteristics are similar to groundwater in nearby wells; however, levels of coliform, color and turbidity generally do not meet Drinking Water Standards. Treatment in addition to disinfection would be necessary before surface water from Lake Merced could be used as a potable water supply. The San Francisco Public Utilities Commission has established a policy that Lake Merced be maintained as an emergency potable water source, and the City's draft Emergency Operations Plan identifies Lake Merced as an emergency water supply for use in fire fighting and sanitary controls.

Beneficial Uses. In the late 1800s and early 1900s, Lake Merced was used as a potable water supply. After the City acquired the lake and surrounding land from the Spring Valley Water Company in 1930, it was designated as an emergency water supply when high quality Hetch Hetchy water became available for City drinking water in 1934. In 1950, the PUC delegated authority to manage the surface of the Lake Merced tract to the Recreation and Park Commission, while retaining authority to use the land for its primary purpose of water supply. Beneficial uses of Lake Merced designated in the 1986 San Francisco Bay Water Quality Control Plan (Basin Plan)[15] include potential municipal supply (primarily as emergency fire fighting water supply), recreation and fish and wildlife habitat.

Development and Management Considerations

The Westside Basin is considered to have high potential for future groundwater development based on the following factors: (1) it has the largest capacity of the groundwater basins in the City; (2) it has the highest volume of recharge of the groundwater basins in the City; (3) the

[15] California Regional Water Quality Control Board, *Water Quality Control Plan, San Francisco Bay Basin, Region (2),* December 1986.

aquifer thickness is relatively large compared to other aquifers in the City; and (4) groundwater quality appears to be of potable quality.

Current groundwater pumping is highly developed in all areas of the Westside Basin except for the Sunset District, which based on modeling of groundwater pumping scenarios is indicated to be the most promising area for future development. A groundwater model prepared by AGS for subsidence indicated that at a steady state pumping rate of 1400 gallons per minute (gpm) (or about 2,250 ac-ft/yr) in the area north of Lake Merced, up to about one foot of subsidence could occur throughout the Sunset District.[16] Another groundwater model prepared by CH2M Hill for saltwater intrusion indicated that the safe pumping rate necessary to prevent saltwater intrusion is about 620 gpm (or about 1,000 ac-ft/yr).[17]

There appears to be an overdraft situation in the Westside Basin south of Lake Merced, due to groundwater pumping levels exceeding the recharge rate in this part of the aquifer. Studies have indicated that it is likely that water levels in Lake Merced have been declining in the last three decades because of groundwater overdraft in deep aquifers (discussed above, under Lake Merced). In addition, water levels in deep pumping wells south of the City have also been declining as further evidence of overdraft conditions.

Downtown Basin

Basin Characteristics

Hydrologic Setting. The Downtown Basin is the largest of the eastside basins, with an areal extent of approximately 7,500 acres (see Figure 50, p. 154). The Downtown Basin is bounded by a bedrock ridge that extends southwest through Russian Hill and Pacific Heights and continues south through Twin Peaks, which separates the Downtown Basin from the Marina, Lobos and Westside basins. The Downtown Basin is open to the San Francisco Bay on the east, and is separated from the Islais Valley basin by a bedrock ridge that extends south from Twin Peaks and Diamond Heights, and then east and northeast to Potrero Point. The basin is underlain by bedrock, with thickness of unconsolidated sediments ranging from zero to about 200 feet. Groundwater flow in the Downtown Basin is generally from the bedrock ridges towards historic creek beds in low-lying areas which have been filled during development of the City, and then to the San Francisco Bay.

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[16] CH2M Hill/AGS, Inc., *Technical Memorandum 11, Subsidence Modeling of Westside and Lobos Basins, San Francisco Groundwater Master Plan*, 1994.

[17] CH2M Hill/AGS, Inc., *Technical Memorandum 14, Saltwater Intrusion Model*, May 1995.

Basin Recharge. Annual total recharge of the basin is estimated to be approximately 5,900 ac-ft/yr (Table 10, p. 79), the largest for any of the eastside basins. A large portion of the estimated recharge is due to leakage from the high density of sewer and water delivery pipes in the downtown area.

Basin Discharge. Groundwater discharge in the Downtown Basin includes pumping for dewatering, pumping for non-potable uses, and outflow to the San Francisco Bay. The relatively high water table in the Downtown Basin necessitates dewatering operations for building foundations, underground structures (i.e., BART stations) and construction sites. Most pumped groundwater goes directly to the sewer. The San Francisco Department of Public Works estimates that dewatering operations contribute an average of 5,600 ac-ft/yr to sewer flow. Known dewatering sites in the Downtown Basin include the Powell Street BART station (Powell and Market Streets), the California State Automobile Association Building (100 Van Ness Avenue), the Adam Grant Building (114 Sansome Street), the Emporium Building (835 Market Street), Fox Plaza (1390 Market Street), the Wells Fargo Building (155 Fifth Street), the Bank of America Building (555 California Street), and the War Memorial Opera House and City Hall, both at the San Francisco Civic Center. Other active wells in the Downtown Basin currently pump groundwater for uses such as fountains, toilets, irrigation or boiler water. The estimated recharge of 5,900 ac-ft/yr, minus the estimated dewatering withdrawal of 5,600 ac-ft/yr, results in a surplus of approximately 300 ac-ft/yr, which currently flows to the San Francisco Bay.

Water Quality. Field investigations have been conducted to gather information on the groundwater quality of the Downtown Basin.[18] Groundwater samples were taken at 20 existing wells located throughout the basin and at temporary dewatering wells at the construction site of the New San Francisco Main Library at the Civic Center. Because there are a relatively high number of locations of known sites with toxic contamination in the Downtown Basin resulting from historic industrial and manufacturing land uses, groundwater in the Downtown Basin is not expected to be potable. Groundwater samples were analyzed for general mineral content, general physical parameters and inorganic constituents. Results of preliminary sampling indicate that groundwater from 19 of the 20 wells is suitable for selected non-potable municipal and industrial uses (e.g., toilet flushing) without treatment. For the parameters analyzed, groundwater from four of the wells met Drinking Water Standards; however, not all parameters regulated under Drinking Water Standards were analyzed and groundwater from those wells cannot be evaluated

[18] CH2M Hill/AGS, Inc., *Groundwater Master Plan Technical Memorandum 9, Downtown Basin Field Investigation Program*, January 31, 1994.

for potential potable water uses until groundwater samples are analyzed for all regulated drinking water constituents.

Existing Wells. Existing wells in the Downtown Basin are used primarily for dewatering of basements, with discharge to the sewers, but groundwater is also used for fountains, toilets, irrigation, boiler water, or other non-potable uses. As part of the GWMP, the groundwater dewatering well at the Powell Street BART Station was identified as a short-term activity which would transfer groundwater currently being pumped and discharged to the sewer to the Auxiliary Water Supply System for use in fire fighting.[19] The existing Powell Street BART Station dewatering system is described above on p. 101.

Development and Management Considerations

Groundwater levels in parts of the Downtown Basin are higher than basements and other subsurface facilities. With few exceptions, groundwater at these facilities is collected by dewatering systems and conveyed to City sewers. Capturing the groundwater produced by dewatering operations is one of the long-term strategies identified in the GWMP to increase groundwater use. While groundwater in the Downtown Basin is not expected to be potable due to historic industrial and manufacturing land uses in the area, groundwater from dewatering operations could be appropriate for selected non-potable uses (e.g., toilet flushing). Because the Downtown Basin has a relatively large capacity and a high recharge rate, the Downtown Basin is considered to have potential for future groundwater development for selected non-potable uses.

Lobos Basin and Lobos Creek

Basin Characteristics

Hydrologic Setting. The Lobos Basin encompasses approximately 2,400 acres in the northwestern corner of the San Francisco peninsula (see Figure 50, p. 154). The Lobos Basin is separated from the Westside Basin by a northwest trending bedrock ridge through the northeastern part of Golden Gate Park, and from the Marina Basin by a north trending bedrock ridge. The Lobos Basin is open on the west side to the Pacific Ocean. The basin is underlain by bedrock, and the water-bearing sediments are dune sands and Colma Formation sediments, ranging in thickness from zero to about 200 feet. Groundwater movement is generally towards Lobos Creek and then towards the Pacific Ocean.

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[19] CH2M Hill/AGS, Inc., *Groundwater Master Plan Technical Memorandum 12c, Design of Facilities to Capture Groundwater Produced by Dewatering Operations*, June 27, 1994.

Basin Recharge. Annual total recharge of the basin is estimated to be approximately 1,600 ac-ft/yr. Major sources of recharge to the Lobos Basin include deep percolation of rain water, applied irrigation water, and leakage from water and wastewater pipes.

Basin Discharge. Groundwater discharge in the Lobos Basin includes seepage to Lobos Creek, removal by pumping, and groundwater outflow to the Pacific Ocean. The overall discharge estimated in 1992 was reported at 2,300 ac-ft/yr, of which 1,800 ac-ft/yr was Lobos Creek surface flow and about 500 ac-ft/yr was attributed to groundwater extraction.[20] Prior to the fall of 1994, essentially the entire flow of Lobos Creek was diverted from its natural outlet to the Pacific Ocean to an existing water treatment plant at the Presidio, where it was combined with groundwater and treated prior to distribution as a potable water supply for the Presidio. Wells located in the Presidio were used to pump groundwater to supplement the potable water supply and to irrigate the golf course. Between 1978 and 1989, average pumpage for municipal purposes was approximately 300 ac-ft/yr, and average pumpage for irrigation of the Presidio Golf Course is estimated to be approximately 200 ac-ft/yr.

Since the fall of 1994, when the jurisdiction of the Presidio transferred from the U.S. Army to the National Park Service, the existing water treatment plant is undergoing rehabilitation. Flow diversions from Lobos Creek have been temporarily discontinued, and the creek flow discharges will be to the ocean until the rehabilitation is completed in 1996. Groundwater pumping for potable use has also been discontinued, and the Presidio is using SFWD water for its potable water supply during the interim. When the water treatment plant rehabilitation is completed, the Presidio will revert to Lobos Creek for its water supply (discontinuing use of SFWD water), and diversion of Lobos Creek flow to the water treatment plant will resume. Groundwater pumping is not anticipated to be necessary, since the Presidio's water demand has decreased from former levels under the U.S. Army, since buildings have been demolished and the population being served at the Presidio has been reduced. Flow diversion in Lobos Creek is also anticipated to be reduced, although the future diversion levels are not known at this time.[21]

Based on the previous discharge rate of about 2,300 ac-ft/yr and the estimated recharge rate of about 1,600 ac-ft/yr, it appears that discharge was exceeding recharge by about 700 ac-ft/yr in the Lobos Basin. This conclusion has been questioned based on the relatively constant level of Lobos Creek for 70 years, although evidence of a 7-foot drop in the water table from 1988 to

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[20] CH2M Hill/AGS, Inc., *San Francisco Groundwater Master Plan, Technical Memorandum 4, Groundwater Resources*, June 23, 1993.

[21] Hadley, Richard, Environmental Specialist, National Park Service, Golden Gate Recreation Area, personal communication with Michele Bellows, Orion Environmental Associates, April 18, 1995.

1992 measured at St. Anne's Home and at the French Hospital would support the conclusion that overdraft conditions have occurred.[22] In 1989, Yates of the U.S. Geological Survey estimated a groundwater budget for the Lobos Basin and estimated that groundwater outflows exceed inflows by about 220 ac-ft/yr. This analysis was based on a recharge volume of 2,123 ac-ft/yr and a discharge volume of 2,343 ac-ft/yr.[23]

Water Quality. Field investigations were conducted in 1993 to gather information on the groundwater quality of the Lobos Basin.[24] Samples of groundwater collected from existing wells plus review of water quality data collected from other wells in the basin and from Lobos Creek indicate that groundwater quality in the Lobos Basin, in general, meets Drinking Water Standards for the constituents analyzed, although some exceedances of some parameters have been reported. Additional laboratory analyses would be required for all regulated drinking water constituents to determine the overall suitability of groundwater in the Lobos Basin for potable water.

The preliminary groundwater sampling indicated that Drinking Water Standards were exceeded at Lobos Creek for coliform bacteria, color, turbidity and manganese. Groundwater from various wells in the basin exhibited exceedances of the Drinking Water Standards for one or more of the following: iron, manganese, gross beta radiation, color, turbidity, chromium, and conductivity. At six of the wells sampled, the groundwater met Drinking Water Standards for the parameters analyzed; however, groundwater from those wells cannot be evaluated for potable water uses until groundwater samples are analyzed for all constituents regulated under Drinking Water Standards. Previous use of Lobos Creek for drinking water supply involved treatment (disinfection) at the water treatment plant, although groundwater has been used for drinking water without treatment.

There are relatively few sites in the Lobos Basin with known toxic releases.

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22 CH2M Hill/AGS, Inc., *Groundwater Master Plan, Technical Memorandum 4, Groundwater Resources*, June 23, 1993.

23 Yates, Gus, U. S. Geological Survey, *Lobos Creek Basin Hydrology*, dated November 7, 1989. Attachment 1 in Geo/Resource Consultants and James M. Montgomery Consulting Engineers, *Groundwater Assessment and Drought Response for The Presidio*, San Francisco, California, August 1991.

24 CH2M Hill/AGS, Inc., *Groundwater Master Plan, Field Technical Memorandum Number 10, Lobos Basin*, March 2, 1994.

Lobos Creek

Lobos Creek is the last remaining free-flowing creek in San Francisco. Historically, it had a surface drainage area of about 4.45 square miles which extended to parts of the Presidio, the Richmond District, Golden Gate Park, and south to Twin Peaks.[25] Currently the surface drainage area is minimal, confined to the immediate open areas adjacent to the creek, since the urbanized, paved portions of the City now drain to the combined sewer system. Lobos Creek is thought to be entirely fed by groundwater seepage. Flow in the creek originates from a series of springs and seeps, primarily on the south bank of the channel, which occur over a reach approximately one half mile long between 18th Avenue and Lincoln Boulevard. A diversion structure that lies immediately downstream of Lincoln Boulevard is used to divert flow from Lobos Creek to a water treatment plant at the Presidio for treatment and then distribution to the Presidio. Until 1994, Lobos Creek provided about 90% of the potable water supply for the Presidio, which was supplemented by groundwater pumpage and purchased water from the San Francisco Water Department. Flow diversions from Lobos Creek have been temporarily discontinued during the rehabilitation of the Presidio's water treatment plant and are anticipated to resume in the spring of 1996.

Historic and current records of diversions from Lobos Creek into the treatment plant indicate that the creek supplied an average of 1.5 to 2.0 million gallons per day, since the early part of the 1900s through 1990.[26] The historic flow rate of Lobos Creek has decreased during the 1900s as a result of the installation of irrigation and drinking water wells in the 1920s. The flow rate of Lobos Creek was estimated to be approximately 1.6 mgd (1,800 ac-ft/yr) in 1985.

The flowing portion of Lobos Creek represents a surface expression of the groundwater table of the Lobos Basin. This theory was supported by field data collected in 1991 as part of an aquifer testing program. The creek virtually intercepts all of the groundwater which flows from the south at elevations above the channel bottom.[27]

Mountain Lake, which is located east of the head of Lobos Creek and east of Highway 1, is also located in the Lobos Basin. It was historically a water supply source for the City. It also appears

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25 Geo/Resource Consultants, Inc. and James M. Montgomery Consulting Engineers, Inc., *Groundwater Assessment and Drought Response for the Presidio, San Francisco, California*, prepared for the City and County of San Francisco, July 1991.

26 Nolte and Associates, *Water Supply Evaluation Presidio of San Francisco*, 90% Submittal Report, Volume 1, prepared for National Park Service, March 1992.

27 ibid.

to be fed by groundwater through springs, and Mountain Lake appears to be directly connected with the groundwater table in the Lobos Basin. Although Mountain Lake and Lobos Creek are both located within the Lobos Basin, the hydraulic connection between the two water bodies is not well understood. Mountain Lake and Lobos Creek are probably hydrologically connected, but groundwater in the Mountain Lake area apparently cannot flow by a direct path to Lobos Creek. It appears that outflow from Mountain Lake enters the regional aquifer prior to blending with groundwater flowing from the south which feeds Lobos Creek, and water originating from Mountain Lake represents a small contribution to Lobos Creek flow.[28]

Development and Management Considerations

Currently, the primary groundwater/water resources in the basin for potential water development are Lobos Creek and the Presidio wells. The Lobos Basin is considered to have a medium potential for additional development as a groundwater supply. Groundwater potential in the basin has recently been partially developed at the Presidio, where the three Presidio wells, have been used for municipal water supply and irrigation purposes. It appears that under 1993 conditions, discharge may have exceeded recharge in the Lobos Basin, indicating a possible overdraft situation. However, since jurisdiction of the Presidio has been transferred from the U.S. Army to the National Park Service, the City and the National Park Service are working jointly to develop a groundwater management plan for the basin. There is potential for developing a conjunctive use program that would maximize use of the basin without endangering City or park resources. Use of recycled water for irrigation in the Presidio could also make available local water supplies that could be directed to other uses.

Marina Basin

Basin Characteristics

Hydrologic Setting. The areal extent of the Marina Basin is approximately 2,200 acres, located in the northern part of the City, north of both Lobos and Downtown basins (see Figure 50, p. 154). The Marina Basin is separated from the Lobos Basin by a northwest trending bedrock ridge that runs through the Presidio, and from the Downtown Basin by a bedrock ridge that runs through Pacific Heights and Russian Hill. To the north, the basin is open to the bay. The

[28] Geo/Resource Consultants, Inc. and James M. Montgomery Consulting Engineers, Inc., *Groundwater Assessment and Drought Response for the Presidio, San Francisco, California*, prepared for the City and County of San Francisco, July 1991.

alluvial thickness varies from zero to 200 feet. In general, groundwater is shallow and groundwater flow is from the bedrock ridges toward the bay.[29]

In the Marina District, artificial fill has been placed over the historic drainage course, El Polin Creek and beyond the natural shoreline during the early growth of the City; the fill overlies bay mud. In the northern portion of the Marina Basin, the subsurface soils consist of about 10 to 85 feet of bay mud overlain by up to 27 feet of sandy fill. In the southern portion of the basin, the soils consist of up to 40 feet of bay mud overlain by dune sands generally 20 to 40 feet thick. Due to the characteristics of bay mud of low hydraulic conductivity and high compressibility, there is the potential for subsidence of the ground surface if groundwater pumping creates pressure on the bay mud.[30]

Water Balance and Water Quality. Groundwater recharge in the Marina Basin is estimated to be 1,300 ac-ft/yr. Although historically there were wells pumping groundwater in this part of the City, there are currently no known groundwater users, and the amount, if any, of groundwater extracted is unknown. It is likely that most of the recharge amount flows from the basin as discharge to the bay. Water quality in the Marina Basin is unknown, although there are identified sites with hazardous waste contamination in this area that may or may not affect the groundwater quality, depending on the nature and extent of the contamination.

Development and Management Considerations

The Marina Basin has a relatively low aquifer thickness, relatively high potential for subsidence, and water quality is expected to be poor. Therefore, the Marina Basin is considered to have a low potential for development. However, pending future studies to address subsidence possibilities and the unknown water quality, this basin may be considered for future groundwater development.

Islais Valley Basin

Basin Characteristics

Hydrologic Setting. The areal extent of Islais Valley Basin is approximately 5,600 acres, with about 600 acres extending south of the City line (see Figure 50, p. 154). The northern boundary

[29] CH2M Hill/AGS, Inc., *Groundwater Master Plan, Technical Memorandum 4, Groundwater Resources*, June 23, 1993.
[30] ibid.

of the basin is a continuous bedrock ridge that runs from Potrero Point to Bernal Heights, Diamond Heights and Twin Peaks, separating this basin from the Downtown Basin. Another bedrock ridge extends west from Hunters Point to Highway 280 and then south to the northern edge of the San Bruno Mountains and forms the southeastern boundary. This same ridge continues along the northern edge of the San Bruno Mountains and then goes north to Mt. Davidson and Twin Peaks, making the south and west basin boundaries, and separating it from the South, Visitacion Valley and Westside basins. The east end of the basin extends into San Francisco Bay. The alluvial thickness ranges from zero feet where bedrock is exposed to 200 feet near the bay.

The unconsolidated sediments are made up of a combination of Colma Formation sediments and undifferentiated alluvial deposits. Bay mud occurs in a large portion of the basin, and artificial fill has been placed over the bay. In general, the water table is shallow and the groundwater flow direction is from the bedrock ridges towards the valley center and then toward the bay. Historically, Islais Creek flowed along the valley and was used for irrigation and domestic use. Islais Creek was filled with blasted rock during the 1940s and was one of the last creeks in the City to be filled.[31]

Water Balance and Quality. Groundwater recharge in the Islais Valley Basin is estimated to be 1,800 ac-ft/yr, and discharge from the basin is mainly outflow to the Bay, estimated to be about 2,000 ac-ft/yr. Historically there were numerous wells with high capacity yield in this basin, but currently, there is one known active well of unknown capacity. Water quality in this basin is unknown, although there are known sites of hazardous waste contamination from current and previous land uses, primarily in the industrial area east of Highway 101.

Development and Management Considerations

There is insufficient data on the Islais Valley Basin to determine its development potential. The hydrogeology, subsidence potential, and water quality of the basin need to be further investigated prior to considering development of the groundwater.

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[31] CH2M Hill/AGS, Inc., *Groundwater Master Plan, Technical Memorandum 4, Groundwater Resources*, June 23, 1993.

South Basin

Basin Characteristics

Hydrologic Setting. South Basin covers about 2,100 acres within the southeast part of the City (see Figure 50, p. 154). It is separated from the Islais Valley Basin by a bedrock ridge that extends from Hunters Point west to Highway 280, southwest to McLaren Park and east to Candlestick Point. The eastern side of the basin is open to the Bay. The unconsolidated sediments have a maximum thickness of 200 feet. The eastern part of the South Basin has been artificially filled beyond the historic shoreline, where bay mud is overlain by artificial fill. Other unconsolidated sediments are mainly slope debris and ravine fill. In general, the water table is shallow and the basic groundwater flow is eastward towards the Bay. Historically, there were two small creeks flowing from the bedrock to the Bay, terminating in a marsh area adjacent to the shore, but both creeks were filled during development of the City.[32]

Water Balance and Water Quality. Estimated recharge in the South Basin is 700 ac-ft/yr, and the majority of this recharge is discharged to the bay. There are three active wells in the basin used for residential irrigation, but the capacity is unknown. Historically, there were over 70 active wells in the South Basin. Water quality in this basin is not well documented, but there are many sites that have had known releases of toxic substances, located predominantly in the industrial area east of Highway 101.

Development and Management Considerations

Although there is limited data available on the South Basin, the estimated recharge rate is the smallest of all basins in the City, unconsolidated sediments are thin, and the water table is shallow. The potential for groundwater development appears limited, though further studies would be needed to determine the development potential.

Visitacion Valley Basin

Basin Characteristics

Hydrologic Setting. The Visitacion Valley Basin is located predominantly south of the City boundary, with an overall areal extent of 4,300 acres but only 800 acres within San Francisco

[32] CH2M Hill/AGS, Inc., *Groundwater Master Plan, Technical Memorandum 4, Groundwater Resources*, June 23, 1993.

(see Figure 50, p. 154). It is separated from the South Basin by a continuous bedrock ridge from Candlestick Point and continues west to McLaren Park. The thickness of the aquifer ranges from zero to 200 feet. As shown in Figure 50 (p. 154), a large portion of this basin has exposed bedrock at the land surface and much of the remaining land surface was created by artificial fill. There are limited data on the geologic properties and groundwater flow of this basin.[33]

Water Balance and Water Quality. There is insufficient information to determine basin recharge or discharge rates. There is one known active well in the City's portion of this basin in a residential area in Visitacion Valley, and historically there were about 30 wells in this basin. Data on water quality are limited, and there are relatively few identified sites with toxic releases.

Development and Management Considerations

There is limited information on groundwater flow regime and water quality of the Visitacion Valley Basin. Additional data collection is necessary to determine the development potential.

RECYCLED WATER MASTER PLAN PROJECT SITES - GROUNDWATER CONDITIONS

Recycled Water Treatment Plant - Fleishhacker Pool Site

Groundwater data from a 1976 investigation of the Fleishhacker site by Harding Lawson Associates (HLA)[34] reported that water was encountered at depths between 5.6 and 8.6 feet above mean sea level (msl) in observation wells. Static groundwater level in a shallow observation well along the Great Highway at the neighboring Oceanside WPCP construction site was reported to be 5.5 feet above msl in December 1991.[35] Groundwater observations at the Oceanside WPCP site also indicated that the groundwater gradient is directly westward toward the Pacific Ocean. Some of the same HLA wells monitored in 1976 were again monitored in 1992 -1993 during the Lake Merced Transport construction project and found to have groundwater levels ranging from 6.4 to 8.3 feet msl. An observation well (a static piezometer) was installed at the northwest corner of the Fleishhacker pool site (immediately east of the Westside Pump Station berm) for monitoring dewatering effects of the Lake Merced Transport construction project. After dewatering ceased, water levels in the observation well rose to

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[33] CH2M Hill/AGS, Inc., *Groundwater Master Plan, Technical Memorandum 4, Groundwater Resources*, June 23, 1993.

[34] Harding Lawson Associates, *Westside Transport Soil Investigation, Phase 1*, prepared for City and County of San Francisco, Department of Public Works, 1976.

[35] Unpublished groundwater level monitoring data collected by Orion Environmental Associates, 1990.

3.9 feet above msl.[36] Ground surface elevation in the center of the Fleishhacker pool is approximately 6.7 above feet msl. Therefore, based on monitoring data, depth to groundwater is likely to be approximately one to two feet below the ground surface in the center of the site.

Lincoln High School - Reservoir Site

The Lincoln High School reservoir site, the football field, has variable fill of up to approximately 30 feet thick overlying fractured Franciscan complex bedrock. Groundwater was encountered in 1967 borings at between 18 and 32 feet below ground surface. The groundwater is likely to be encountered near the soil/bedrock contact and may be present as seepage at the bedrock/soil contact or within the native soil beneath the imported fill. In general, given the prevailing topography, the groundwater flow may be to the south-southwest. No groundwater quality data are available for this specific site.[37]

McLaren Park - Reservoir Site

Two prospective locations for the reservoir were reviewed by Geo/Resource Consultants based on site visits and published reports; no subsurface exploration was conducted.[38] Both sites are located on the north side of Mansell Street along the east-west ridge that extends through McLaren Park. Franciscan complex chert and sandstone rock outcrops are evident at the two sites. Bedrock is likely to be encountered at the two sites within a depth of 25 feet. Only a thin layer of soil overlays the bedrock in this ridge area. At site 1, the native and fill soils are likely shallow, while site 2 may be underlain by deeper fill materials. The soils are likely a mixture of alluvial clay and silts with fill materials added in the downslope areas of the two sites. Slopes at McLaren Park can be steep, up to 25%, but are flat at the proposed reservoir sites. Groundwater may occur as seepage at the bedrock/soil interface. Other groundwater levels in this area are likely influenced by any localized variations in the bedrock surface or rock type. No measurable groundwater is likely at the ridgetop location proposed for the reservoirs. In general, groundwater in this area would generally flow in any direction away from the ridge top and would likely flow to the east or west at site 1 and to the north at site 2. No groundwater quality data are available for this site.

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[36] Unpublished groundwater level monitoring data collected by Orion Environmental Associates, 1991 - 1993.
[37] Geo/Resource Consultants, Inc., *Technical Memorandum, San Francisco Water Recycling Master Plan, Geotechnical Review, Lincoln High School and McCoppin Square*, August 15, 1994.
[38] Geo/Resource Consultants, Inc., *Technical Memorandum, San Francisco Water Recycling Master Plan, Geotechnical Review, John McLaren Park*, June 23, 1995.

C. PUBLIC HEALTH AND WATER QUALITY

This section summarizes the current status of public health and water quality studies related to development and use of recycled water and groundwater. The primary water quality concern is to assure protection of public health, whether for groundwater or recycled water or for potable or non-potable uses. Public health effects depends on a number of factors, including the concentration of harmful substances in the water, the potential for public exposure to the water (such as through direct or indirect contact, inhalation or ingestion), the actual dose received by an individual, and the concentration necessary to effect a response in an individual.

For the RWMP, all of the proposed uses would be non-potable, and there are public health concerns associated with potential exposure to recycled water via any of the proposed uses, including landscape irrigation, industrial uses, and fire fighting. Other recycled water quality issues important for non-potable uses include: (1) irrigation water quality and the potential effects on plants and soils, and (2) commercial/industrial water quality and the potential effects on piping and industrial process systems.

For the GWMP, the proposed uses include potable as well as non-potable uses, and drinking water standards related to both public health and aesthetic concerns are also considered. In addition to public health concerns, water quality of potable water also affects its taste, odor and appearance.

Regulatory requirements regarding both drinking water quality and recycled water quality have been established to protect public health. In California, the major pieces of water quality legislation affecting the RWMP and GWMP are the California Safe Drinking Water Act (Title 22, Division 4, Chapter 15 of the *California Code of Regulations*) and Wastewater Reclamation Criteria (Title 22, Division 4, Chapter 3 of the *California Code of Regulations*), regulating drinking water and recycled water respectively. These regulations are discussed in Appendix B, Regulatory Background for RWMP/GWMP, of this report.

PUBLIC HEALTH AND DRINKING WATER QUALITY

The Safe Drinking Water Act and Amendments established drinking water standards, which are grouped into primary and secondary standards. Primary standards are designed to protect public health and define maximum contaminant levels, which the government has determined are the safe levels in drinking water for chemicals known to cause human health effects. Secondary

standards are designed to protect the public welfare for non-health concerns such as taste, odor or appearance of the water; maximum contaminant levels have also been established for secondary standards. Maximum contaminant levels are legally enforceable standards that must be achieved by water suppliers at the water treatment plant, before drinking water is delivered to the consumer. Water suppliers are required to test and regularly monitor drinking water for the presence of chemical contaminants, and they are required to report and notify the public of any violations of the maximum contaminant levels. In San Francisco, the San Francisco Water Department and the Department of Public Health are responsible for assuring that the drinking water is safe for public health.

PUBLIC HEALTH AND RECYCLED WATER QUALITY

Current Uses of Recycled Water

The Water Reuse Association of California conducted a survey in 1993 that determined that at least 383,572 acre-feet (125 billion gallons) of recycled water was in use in California.[1] This amount was a 40% increase over a previous survey in 1987, and the volume of recycled water use is projected to continue to increase. The breakdown of types of uses surveyed in 1993 is as follows: landscape irrigation (12%), industrial (2%), agricultural (20%), groundwater recharge (48%), seawater intrusion barrier (2%), environmental uses (8%), and miscellaneous uses, including fire protection (8%). Of the 1993 volume of use, over two thirds (69%) of the recycled water was used in Southern California, while only 6% was used in the San Francisco Bay area.

Health Effects of Recycled Water

Public health effects associated with the use of recycled water has been the subject of numerous studies and investigations throughout California over the past twenty years. The results of the studies and the current level of recycled water use in California demonstrate that for non-potable uses, recycled water that meets accepted water quality standards has not resulted in public health effects. In fact, current public health studies are being conducted on the potential potable use of recycled water.[2] The following discussion presents a summary of a literature search on public health effects associated with use of recycled water for non-potable uses and the results of numerous studies.

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1 Water Reuse Association of California, *Survey of Future Water Reclamation Potential,* Final Report, July 1993.
2 Cooper, Robert C., *Public Health Concerns in Wastewater Reuse, Water Science Technology*, Volume 24, No. 9, pp. 55-65, 1991.

Because the source of recycled wastewater is domestic sewage, there are public health issues related to the known presence of pathogenic microorganisms and various chemicals in untreated wastewater. By and large, studies have indicated that with proper attention to water quality standards and reclamation plant reliability, high quality water can be produced which should not pose an increased risk of disease to those using the water.[3] The two main categories of health concerns are pathogens and chemicals, as discussed below.

Pathogens

Infectious disease agents or pathogens that could be found in wastewater include bacteria, viruses, and parasites. The types and concentrations of these substances, however, depend upon the sanitation practices of a specific community. The potential for transmittal of infectious disease associated with using recycled wastewater is dependent upon a number of factors, including actual exposure to the pathogenic organisms (i.e., dose), the amount required to cause disease(i.e., response), and the treatment and disinfection processes used to produce recycled water.

Wastewater treatment processes are known to provide effective removal of pathogenic substances and to reduce the concentrations of these substances to levels which meet the State's Wastewater Reclamation Criteria. Standard monitoring requirements, such as measurement of coliform bacteria, are useful tools in assuring the treatment processes are operating effectively. In California, the coliform standard for recycled water is 2.2 total coliform per 100 milliliters, which is 100 times lower than the comparable standard established by the World Health Organization. For both standards, mathematical modeling of health risk indicates that if recycled water that meets these standards is used for water contact sports (such as swimming), then the public health risk of enteric disease would not be detectable over the background levels.[4]

Studies on the health risk associated with exposure to wastewater focused on workers at wastewater treatment plants, since these workers have much higher exposure to wastewater than the general public and the wastewater is either untreated or partially treated. Overall, the studies have shown that the risk of infectious disease among sewage plant workers is minimal.[5]

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3 Cooper, Robert C., *Public Health Concerns in Wastewater Reuse*, *Water Science Technology*, Volume 24, No. 9, pp. 55-65, 1991.
4 ibid.
5 ibid.

Other health studies have specifically addressed human exposure to aerosols or spray from wastewater treatment plants to the surrounding communities. Aerosols are of concern because the particle sizes of aerosols can be inhaled, and inhalation of aerosols could be a potential pathway for transmittal of pathogenic organisms. The results of the studies, however, have indicated that public health effects have not been attributed to wastewater aerosols.[6]

Health effects of viruses in wastewater have been examined, since viruses are generally more resistant to treatment than bacteria. Virus studies conducted in California have shown that there has been no detectable viral hazard associated with current water reuse programs, when using reclaimed wastewater that complies with the California reclamation standard. The studies were conducted over a ten-year period and monitored various reuse categories, including park and landscape irrigation, agricultural irrigation and groundwater recharge. There is evidence that compliance with the California reclamation standard meets the desired objective of producing essentially virus-free reclaimed water.[7] A risk analysis was conducted in 1992 assessing the health risk associated with the presence of human viruses in reclaimed wastewater used for landscape irrigation in an urban environment. The analysis indicated that use of recycled water treated to meet California's wastewater reclamation criteria, while not risk-free, can be determined as safe and within an acceptable level of public health protection.[8]

Chemicals

The chemical constituents potentially present in municipal wastewater are a public health concern primarily when reclaimed wastewater is considered for potable reuse. They may also affect the public acceptance when reclaimed water is used for food crop irrigation. Chemical concerns are less important where reclaimed water is not to be consumed, with the exception of possible inhalation of volatile organics from indoor exposure.[9]

Inorganic constituents, such as heavy metals (e.g., cadmium, zinc, nickel and mercury) or nutrients (e.g., nitrogen, phosphorus, potassium), may be present in recycled wastewater. These would not be considered a public health concern unless present in quantities exceeding the maximum contaminant levels established by the EPA and ingested either directly or indirectly

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6 Pharen, H., 1979, *Wastewater Aerosols and Disease Assessment,* in Cooper, 1991.

7 Yanko, William A., *Analysis of 10 Years of Virus Monitoring Data from Los Angeles County Treatment Plants Meeting California Wastewater Reclamation Criteria; Water Environment Research,* Volume 65, Number 3, May/June, 1993.

8 Asano, T., Leong, L.Y.C., Rigby, M.G., and Sakaji, R.H., *Evaluation of the California Wastewater Reclamation Criteria Using Enteric Virus Monitoring Data; Water Science Technology,* Vol. 26, No. 7-8, pp. 1513-1524, 1992.

9 Camp Dresser & McKee Inc., *Guidelines for Water Reuse,* published by Camp Dresser & McKee, Cambridge, Massachusetts, October 1992.

through food. Presence of these constituents presents more of a concern with regard to irrigation uses (see discussion under Landscape Irrigation Uses, p. 187), although wastewater treatment generally can reduce many trace elements to below recommended maximum levels for irrigation.[10]

Organic substances present in wastewater, such as oil and grease, pesticides, chlorinated hydrocarbons, may originate either from naturally occurring materials or from synthetic compounds. They have been identified to be present in trace amounts in wastewater, and there remain uncertainties regarding long-term health implications associated with acute or chronic exposure to certain organic compounds. A large-scale epidemiological study in Los Angeles was conducted on use of recycled water to recharge groundwater which was used as a potable water supply (i.e., indirect potable use of recycled water, since recycled water was not used directly as a drinking water source but was first injected into the groundwater and the groundwater was then pumped for a drinking water supply). This study indicated no significant differences in health outcomes between residents exposed to groundwater that had been recharged with recycled water and those exposed to water from non-recharge areas.[11]

Similar to inorganic substances, the health concerns associated with the presence of organic constituents in reclaimed wastewater are associated with direct or indirect potable uses rather than with non-potable uses.[12] Use of reclaimed wastewater has not been shown to result in any health effects associated with non-potable uses.[13]

In a current San Diego project, it is being demonstrated that reclaimed water can be produced which is equal to or better in quality than the City of San Diego's current water supply source, and it is anticipated that the risk of disease associated with drinking from the present supply should not be increased if the supply is supplemented with the reclaimed water.[14]

Based on the evidence from the studies described above and on the extent of the current level of use of recycled water, it can be concluded that for non-potable uses, the public health risk associated with exposure to highly treated recycled water that meets California reclamation standards appears negligible.

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10 Camp Dresser & McKee, 1992.
11 Cooper, 1991.
12 Camp Dresser & McKee, 1992 and Cooper, 1991.
13 Cooper, 1991.
14 ibid.

OTHER RECYCLED WATER QUALITY CONSIDERATIONS

Landscape Irrigation

The environmental setting for water quality issues with respect to effects of irrigation with recycled water on landscape plants is discussed in Section IV.J, Biological Resources (p. 236). In addition, use of recycled water for landscape irrigation could be corrosive to irrigation piping, if made of uncoated metal, and depending upon quality of the recycled water and soil and groundwater conditions. Recycled water with high concentrations of chloride and total dissolved solids would be corrosive to uncoated iron, copper and aluminum pipe, and under certain conditions, water with low concentrations of calcium could be corrosive to concrete pipe and to cement mortar used in some pipes. A corrosion control study conducted for the recycled water system is discussed in Section V.A.3, pp. 291-292.

Industrial and Commercial Process Water

Commercial and industrial uses would require water of suitable quality to avoid problems with equipment, piping and industrial process systems. Industrial uses for reclaimed water include evaporative cooling water, boiler feed water, and process water. Commercial uses of recycled water include toilet flushing and office cooling systems. Water quality problems in cooling water systems can include scaling, corrosion, biological growth, fouling and foaming, which are associated with contaminants present in reclaimed water. Excess calcium and magnesium can lead to formation of scale or hard deposits. High total dissolved solids can promote corrosion to metals when acidic conditions occur. Biological growth in cooling systems can occur if nutrients or organics (biological oxygen demand) that promote growth are present and the recycled water is not adequately disinfected. Excess particulate matter can cause fouling if the recycled water is not adequately filtered. Other uses in specific industries could result in specific water quality requirements and may require specific on-site treatment.

D. PUBLIC SERVICES AND UTILITIES

This discussion focuses on three public utilities/services that would be affected by the RWMP and GWMP: the water supply system, the fire protection system, and the wastewater and stormwater system. Both the RWMP and GWMP are water supply plans involving modification and expansion of the City's wastewater and water systems. Implementation of these plans would not affect the following City utilities and services: schools, parks, police, health/medical, and solid waste. For those utilities and services, implementation of the proposed plans would not cause an increase in demand for new services or facilities, a disruption of service, or a change in service levels. Therefore, these services and utilities have not been included in this discussion. Construction of proposed facilities under the RWMP and GWMP would affect City school and park properties but this issue is addressed in Section IV.A, Land Use (p. 112). Energy demand and required utility improvements are discussed in Section V.A.12, Energy (pp. 376 and 377).

WATER SUPPLY SYSTEM

As discussed in Section II, Background (pp. 7 to 28), the San Francisco Water Department delivers water to about 2.3 million people in four counties, and receives about 85% of its supply from the Hetch Hetchy system, and about 15% from other sources (groundwater and Bay Area watersheds). Water is conveyed to the San Francisco Bay Area from the Hetch Hetchy system across the San Joaquin Valley through a series of aqueducts, tunnels, and transmission mains, with open reservoirs providing storage at multiple points along the way.

The discussion in this section focuses on the existing water system within the City and the facilities and operations that could be affected by implementation of the RWMP and GWMP. The effect of the RWMP and GWMP on the City's water supply and ability to meet water demands is discussed in Chapter VI, Water Supply Effects and Growth Inducement Potential of the RWMP and GWMP (pp. 435 to 471).

Transmission lines from the Peninsula deliver water into one or more of four terminal distribution reservoirs in San Francisco.[1] From these reservoirs, water is gravity fed or pumped into eight covered distribution reservoirs, at elevations of 135 to 800 feet, and smaller storage tanks, at elevations from 370 to 900 feet. From these reservoirs and tanks, water is distributed

[1] City and County of San Francisco, *San Francisco Water and Power, A History of the Municipal Water Department and Hetch Hetchy System*, 1994

throughout the City using a network of about 1,190 miles of pipeline of diameter ranging from 2 to 60 inches.

The City's twelve municipal reservoirs can hold, at capacity, approximately 414 million gallons (1,271 acre feet) of water, about a five day supply.[2] Lake Merced could provide an additional 2.5 billion gallons of emergency supply. The City's three largest municipal reservoirs are Sunset (174.8 million gallons), located in the Sunset District, University Mound (140.9 million gallons), located in the Potrero District, and Sutro (31.4 million gallons), located between Mount Sutro and Twin Peaks. A 75-million-gallon reservoir, Balboa North Basin reservoir, is planned to be built and would be the third largest City reservoir. The City operates an ongoing program of pipe repair and replacement of about 30,000 feet of deteriorated pipe per year.

Water treatment including chlorination is provided at multiple points along the water supply system from the Sierra to San Francisco. The City operates a system-wide sampling and testing program to monitor water quality. The two water treatment plants in the system are the 160 million gallon per day (mgd) Sunol Filtration Plant, and the 180 mgd Harry W. Tracy (San Andreas) Water Treatment Plant.

FIRE PROTECTION - AUXILIARY WATER SUPPLY SYSTEM (AWSS)

The Auxiliary Water Supply System (AWSS) is a high-pressure water distribution system operated and maintained by the San Francisco Fire Department (SFFD). This system was initially installed in 1908 in response to the catastrophic fire of 1906. The AWSS is separate from the City's potable water system, and to date has been dedicated solely to fire protection. The AWSS is concentrated in the downtown area of the City, with some extension to the southeast and central parts of the City, as shown in Figure 7 (p. 25).

The major components of the AWSS are reservoirs, high pressure piping system, cisterns, and bay pumping stations.[3] The existing AWSS distribution network conveys non-potable fresh water or salt water to hydrants located mainly in the Downtown, Mission and South of Market areas. The pressure of the AWSS (up to 300 pounds per square inch, psi) is higher than that of the SFWD potable system (40 to 90 psi). Currently, there are three main reservoirs in San Francisco which can provide water to the AWSS hydrants: the Twin Peaks Reservoir, the

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2 City and County of San Francisco, *San Francisco Water and Power, A History of the Municipal Water Department and Hetch Hetchy System,* 1994

3 James M. Montgomery, Consulting Engineers, Inc., *Memorandum, Reclamation Master Plan AWSS Cross Connection Prevention and Remediation Procedures*, November 27, 1991

Ashbury Tank, and the Jones Street Tank. The fresh water present in the Twin Peaks Reservoir and the Ashbury Tank is derived from the San Francisco Water Department potable water supply. However, since adequate disinfection is not maintained in the AWSS reservoirs and the distribution network , the AWSS fire hydrants supply non-potable water. Saltwater has been used extensively in the past to provide an alternate water supply for the AWSS. Due to corrosion-related problems, the use of saltwater in the AWSS is limited to emergencies.

WASTEWATER AND STORMWATER SYSTEM

San Francisco has a combined wastewater and stormwater collection, treatment and disposal system, which includes two year-round and one wet weather water pollution control plants, and about 900 miles of pipes and transport structures. The City's existing wastewater and stormwater system is described in Section II.E, Background (p. 26) and is shown on Figure 8 (p. 28).

E. GEOLOGY, SOILS AND SEISMICITY

CITY OVERVIEW

Regional Geology

The City is located on the northern tip of the San Francisco Peninsula, within the California Coast Ranges geologic province. The Coast Ranges are a northwest trending series of ranges and valleys. The general geologic setting of the City is characterized by bedrock hills bounded by broad valleys underlain by unconsolidated deposits. The bedrock consists of consolidated rocks of the Franciscan Complex and the Great Valley Sequence of late Jurassic and Cretaceous age.[1] The Franciscan Complex generally consists of graywacke (sandstone), shale, chert, greenstone, and melange; in certain places, serpentine, an asbestos-containing rock-type, is found within the shale matrix. The Great Valley Sequence generally consists of sandstone and shale. Bedrock outcrops in hilly areas account for approximately 24 percent of the land surface in San Francisco. The unconsolidated sediments comprise the seven groundwater basins within San Francisco.[2]

On the west side of San Francisco, the unconsolidated sediments consist of the following units described from the oldest (deepest) to the youngest (most shallow):

- the Merced Formation, consisting of Pliocene age shallow marine and estuarine deposits with thin interbedded muds and peats, some thicker beds are known to exist. Tilted fine grained strata within this unit may impede horizontal groundwater flow.
- the Colma Formation, consisting of Pleistocene age fine-grained sand, silty sand, and occasional beds of clay as much as five feet thick. These materials were probably eroded from the Merced Formation and redeposited. The Colma Formation crops out in areas near Lake Merced.
- dune sands, consisting of Pleistocene age well-sorted fine to medium sand. Prevailing westerly winds have swept the sand from Ocean Beach and Bakers Beach to locations throughout the City. This unit underlies more than half of San Francisco and can be up to 150 feet thick.

On the north and east sides of San Francisco, the unconsolidated sediments consist of the Colma Formation and dune sand (described above) as the following units:

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1 Schlocker, J., Geology of the San Francisco North Quadrangle, California, *U.S. Geological Survey Professional Paper 782*, 109p., 1974.

2 Philips, Steven P., Hamlin, Scott N. And Yates, Eugene B., 1993. Geohydrology, Water Quality and Estimation of Ground-Water Recharge in San Francisco, California, 1987-92. U. S. Geological Survey, Water Resources Investigations Report 93-4019. Prepared in Cooperation with the San Francisco Water Department.

- older bay mud deposits, generally consisting of firm, dark greenish gray, silty clay with varying amounts of sand and fine gravel. Deposits of older bay mud are restricted to the bay side of the peninsula.

- younger bay mud, deposited in areas of weak tidal currents and low water turbulence, primarily consisting of soft, gray silty clay. Deposits of younger bay mud are primarily encountered on the bay side of the peninsula. This unit reaches a maximum thickness of approximately 140 feet in San Francisco.

- artificial fill generally consisting of hydraulically placed dredge sands that may contain clay, rock waste from excavations, manmade debris, and organic wastes. This unit reaches a maximum thickness of about 60 feet in San Francisco. Artificial fill is largely concentrated in the bay margin areas on the northern and eastern side of the City. During the mid to late 1800's, artificial fill was used to fill in tidal flats and estuarine marshes to create building pads for residential and commercial development.

- other relatively fine grained surficial deposits such as alluvium, which is soil material transported and deposited by running water. Alluvium generally consists of clayey silty sand and clayey silt with some pebbles.

Regional Soils

Soils in the project area are predominantly silty clays, clays and loams having many similar characteristics; the upland soils tend to be shallower and richer in clay.[3] Typical soil properties are characterized by moderate to high shrink–swell potential, poor to ponded runoff (drainage), moderate corrosivity, low to moderate permeabilities and moderate load-bearing strengths. Fill material is variable in soil properties.

Regional Seismicity

The distribution of earthquakes in northern California is strongly influenced by the major active faults in the region.[4] Figure 55 is a regional fault map showing active faults in the San Francisco Bay region. The active faults considered to have the greatest potential to cause damage in the City are the San Andreas Fault, Seal Cove-San Gregorio Fault, Hayward Fault, and Healdsburg-Rodgers Creek Fault.[5] Table 17 summarizes these faults and the moment magnitude[6] of a

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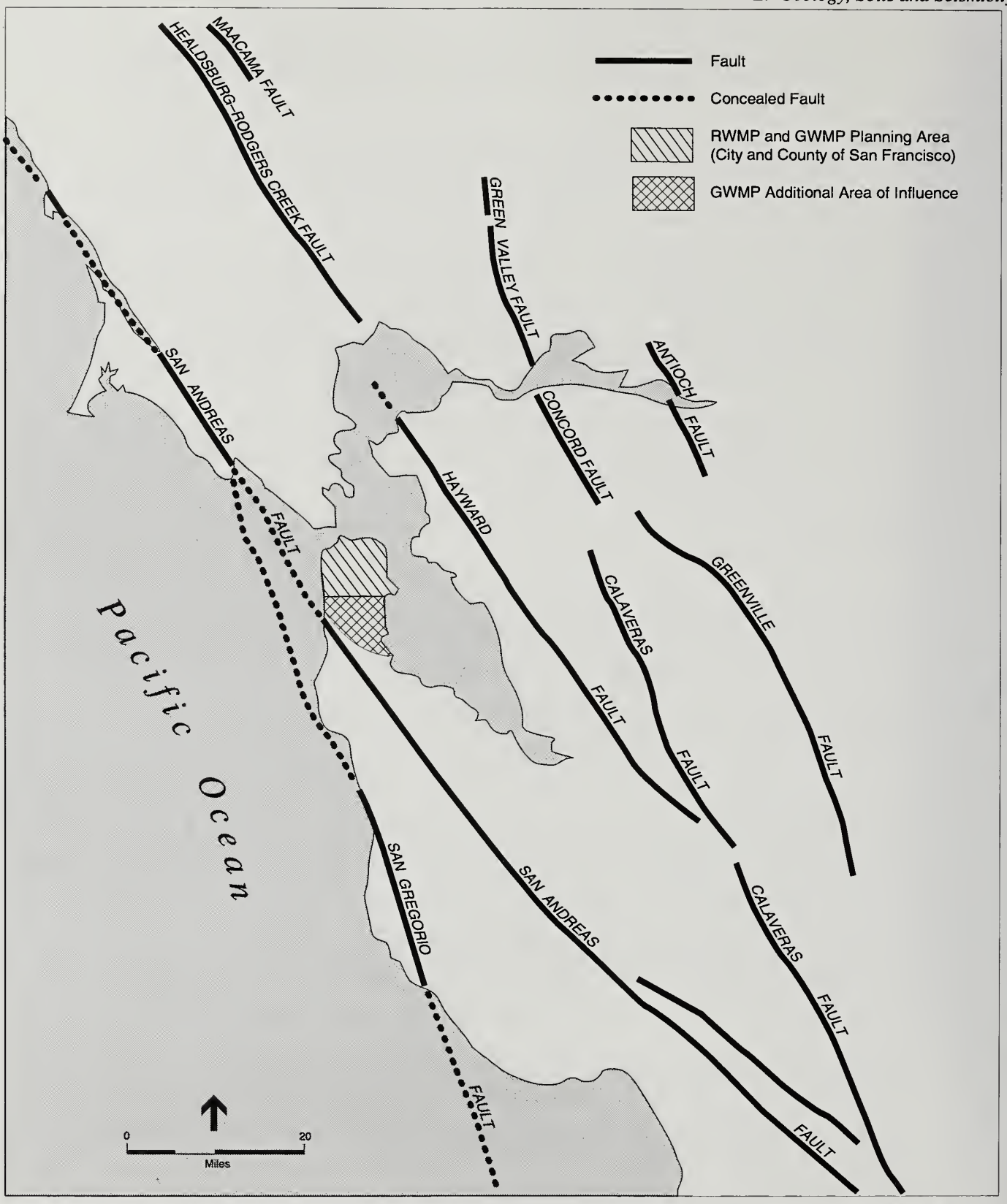
3 Helley, E.J. and K.R. Lajoie, 1979. Flatland Deposits, Their Geology and Engineering Properties and Their Importance to Comprehensive Planning. Selective Examples from the San Francisco Bay Region, California, U.S. G. S. Professional Paper 943.

4 Faults are considered active based either on historical fault rupture or geologic evidence that clearly demonstrates rupture during Holocene time (approximately within the last 11,000 years).

5 Association of Bay Area Governments, 1995. *The San Francisco Bay Area -- On Shaky Ground.* Association of Bay Area Governments, Publication Number P95001EQK, April 1995.

6 The moment magnitude reflects the energy released by an earthquake. It is used by modern seismologists in place of the more familiar Richter magnitude because the Richter magnitude has difficulty differentiating the size of earthquakes with magnitudes greater than 7-1/2. The moment magnitude is proportional to the area of the fault surface that has slipped and to the length of the fault. Weak faults tend to generate earthquakes with moment magnitudes of 5 and 6, while stronger faults can store up enough energy to generate earthquakes of moment magnitude of 7 or more. The Loma Prieta Earthquake of October 1989 had a moment magnitude of 6.9.



SF RWMP / GWMP Program EIR ■

SOURCE: Association of Bay Area Governments, 1995

Figure 55
Regional Fault Map

TABLE 17: DISTANCES AND MOMENT MAGNITUDE OF MAJOR FAULTS IN THE SAN FRANCISCO AREA

Fault Zone	Approximate Distance from San Francisco (miles)	Moment Magnitude of Characteristic Earthquake
San Andreas	3	7.1
Hayward	20	7.3
Seal Cove - San Gregorio	6	7.1
Healdsburg-Rodgers Creek	30	7.1

NOTE: The moment magnitude reflects the energy released by an earthquake. It is used by modern seismologists in place of the more familiar Richter magnitude because the Richter magnitude has difficulty differentiating the size of earthquakes with magnitudes greater than 7-1/2. The moment magnitude is proportional to the area of the fault surface that has slipped and to the length of the fault. Weak faults tend to generate earthquakes with moment magnitudes of 5 and 6, while stronger faults can store up enough energy to generate earthquakes of moment magnitude of 7 or more. The Loma Prieta Earthquake of October 1989 had a moment magnitude of 6.9.

SOURCE: Association of Bay Area Governments, *The San Francisco Bay Area -- On Shaky Ground*, April 1995.

characteristic earthquake that could occur along each fault. Characteristic earthquakes on these faults would be expected to cause moderate to heavy damage along the Bay margin of San Francisco as well as non-structural damage throughout much of the rest of the City. Other active faults in this region which are expected to cause less damage in the City include the Calaveras, Concord, Maacama, Green Valley, West Napa and Greenville faults. Characteristic earthquakes on these faults would be expected to cause non-structural damage along the Bay margin. Damage would not be expected throughout the remainder of the City although unsecured objects may fall.

Local Seismicity

There are no active faults mapped within the City and County of San Francisco.[7] There are four northwest-trending faults or shear zones within the City and northern peninsula area that are

[7] URS Consultants/John A. Blume and Associates, *San Francisco Seismic Safety Investigation*, June 1974.

considered inactive. These are the Diamond Heights Fault, Fort Point-Hunters Point Shear Zone, City College Shear Zone and San Bruno Fault which all trend parallel to the San Andreas Fault.

The Diamond Heights Fault passes through the hilly area of Diamond Heights in the City. The City College Shear Zone trends northwest to southeast, parallel to the San Andreas Fault. This zone extends from Lincoln Park southeastward to San Francisco Bay near the Bayshore. Much of this shear zone has no surface expression and is projected beneath dune sands and alluvial sediments. The fault zone appears to affect only bedrock. The San Bruno Fault parallels the San Bruno Mountains and passes through Lake Merced in a northwesterly direction as does the San Andreas Fault. It is not considered active and has shown no micro-earthquake activity indicative of building strain. The Fort Point-Hunters Point Shear Zone is a zone of varying thickness mainly projected beneath overlying sediments which extends from the Presidio (Fort Point) to the Hunters Point area.

The Loma Prieta earthquake generally caused structural and non-structural damage in some portions of San Francisco. This level of damage is typical of moderate-sized earthquakes. Damage that occurred at distances of up to 50 miles from the epicenter is evidence that the proposed project may be adversely affected by earthquakes occurring on any of the region's major faults. An earthquake of similar or larger magnitude could occur again on the San Andreas, Hayward, Healdsburg-Rodgers Creek or other active Bay Area faults. Other active faults in the region could produce smaller earthquakes.

Geotechnical Hazards

The potential seismic hazards in the City are principally strong ground shaking motion, liquefaction, densification, subsidence, soil lurching or lateral spreading, and minor slumping or slope instability at the upland reservoirs. The potential for fault rupture in San Francisco is low because no known active faults cross the area; the nearest potential fault rupture, as delineated by Alquist-Priolo Studies Zone maps, is the San Andreas Fault located about three miles west of the City. Other hazards related to earthquakes that were considered but determined to be absent from the proposed project site vicinities are major landsliding, subsidence, and tsunami (seismic sea wave).[8]

[8] URS Consultants/John A. Blume and Associates, *San Francisco Seismic Safety Investigation,* June 1974.

General seismic hazards are discussed below. Seismic hazards related to each proposed project site for the RWMP and the GWMP are summarized in Table 18 and are discussed under Impacts, pp. 300 to 306 and 411 to 413. Seismic hazard from ground shaking due to a characteristic earthquake is the most serious hazard to the City. Qualitatively, the estimated intensity of future ground shaking at the various project sites during a characteristic earthquake on the San Andreas Fault ranges from "objects fall (VI)" to "nonstructural damage (VII)" to "moderate damage (VIII)" based on the modified Mercalli intensity scale, which ranges from I to XII. "Nonstructural damage" is the level of shaking intensity experienced by most of San Francisco during the Loma Prieta Earthquake in 1989, except in the Marina and the South of Market areas which experienced liquefaction and ground settlement which resulted in major structural damage (modified Mercalli Intensity damage VIII, "moderate damage"). The type of rock a structure is located on directly affects the intensity of shaking, and therefore the degree of damage that may occur during an earthquake. Deep. Loose soils tend to amplify and prolong shaking. The worst such soils in the Bay Area are the loose clays of the Bay mud that border the Bay margin and filled area.[9] The type of rock that least amplifies the shaking is granite. The remaining materials fall between these two extremes.

Earthquakes can trigger landsliding on potentially unstable ground. In San Francisco, it is anticipated that a major earthquake will cause movement of active slides and can trigger new slides in the same general areas of previous slides. The hills of San Francisco underlain by Franciscan rocks are generally most susceptible to landsliding.

Liquefaction occurs when a saturated cohesionless soil, such as sand, is subjected to a shock and experiences an increase in pore water pressure. The soil loses a substantial amount of strength and may become liquid. Potential consequences of liquefaction include the loss of bearing capacity, differential settlement, lurching, lateral spreading, and increased lateral earth pressures. These can cause serious building foundation failures and naturally buoyant structures such as underground storage tanks may be raised above ground.

Liquefaction more commonly occurs in looser, saturated materials. Dense to very dense sand such as the dune sand is less susceptible to liquefaction. Liquefaction was not reported in the vicinity of the proposed project sites during the 1906 or 1989 earthquakes. The Fleishhacker RWTP location is the only project site that has been identified to date (based on previous investigations) as being in an area of probable liquefaction potential.[10] Densification,

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9 Association of Bay Area Governments, *The San Francisco Bay Area -- On Shaky Ground,* April 1995.
10 URS Consultants/John A. Blume and Associates, *San Francisco Seismic Safety Investigation,* June 1974.

TABLE 18: POTENTIAL GEOLOGIC AND EARTHQUAKE HAZARDS AT RWMP AND GWMP PROJECT SITES

	Type of Hazard					
Project Site	Estimated Damage Level from Earthquake-induced Groundshaking /1/	Landslide Hazard /2/	Liquefaction Hazard /2/	Tsunami Inundation /2/	Inundation Area due to Reservoir Failure /2/	Subsidence Hazard /2/
Fleishhacker	VII-Nonstructural	None	Probable Potential	None	None	None
Lincoln High School	VII-Nonstructural	None	None	None	None	None
McLaren Park	VIII-Moderate	Potential Hazard	None	None	None	None
Elk Glen Well	VII-Nonstructural	None	None	None	None	None
Francis Scott Key School	VII-Nonstructural	None	None	None	None	None
W. Sunset Playground	VII-Nonstructural	None	None	None	Yes, Sunset Reservoir	None
Powell St. BART Station	VII-Nonstructural	None	None	None	None	None

/1/ Modified Mercalli Intensity Damage Level based on San Andreas Earthquake Peninsula Segment, moment magnitude 7.1. SOURCE: Association of Bay Area Governments, *The San Francisco Bay Area -- On Shaky Ground*, April 1995.

/2/ SOURCE: URS/John A. Blume & Associates, Engineers, 1974. *San Francisco Seismic Safety Investigation.* Prepared for The Department of City Planning, City of San Francisco.

subsidence, and differential compaction could also occur in loose to medium dense sands whether saturated or not.

Lurching or lateral spreading, is a related phenomena to liquefaction that can occur when liquefied soils have a free face, such as a creek bed or ocean front without a seawall, towards which to move. Such movements can have the same disastrous consequences as a landslide for a structure that is located on or adjacent to the zone of ground deformation. Only minor lurching occurred in the Marina District of the City during the Loma Prieta earthquake because the seawall held.

Of the geologic units identified in the City, the bedrock of the Franciscan assemblage is the least susceptible to earthquake-related effects (except in isolated areas of intensely sheared rocks where, due to the structural deformation associated with the shearing, it has a much higher potential for landsliding or other earthquake-induced failure). The deposits of the Merced and Colma formations, which consist of unconsolidated sand, silt and clay, have fair to good stability under seismic conditions.[11] The sand dune deposits, with their relatively clean, well-sorted sand, have good earthquake stability characteristics unless the groundwater table is close to the surface or the material is otherwise saturated; in which case they have a high potential for liquefaction and consequent failure during an earthquake. Artificial fills, particularly where placed over Bay muds and loose sand, are highly susceptible to fissuring and subsidence as well as liquefaction where there is near surface saturation.

There was no major damage to structures in the vicinity of the specific project sites due to ground failure from the 1906 or 1989 earthquakes. During the 1989 Loma Prieta earthquake, most of the damage in San Francisco was sustained in the Marina and the South of Market districts due to ground shaking. Buildings in these areas are built on large quantities of fill materials. These areas experienced liquefaction and ground settlements which resulted in major structural damage to numerous buildings and ruptured utility lines which caused fires. In general, the damage was less in areas of the City underlain by firmer soils such as the Merced and Colma formations.

RECYCLED WATER MASTER PLAN PROJECT SITES

Recycled Water Treatment Plant - Fleishhacker Pool Site

A geotechnical study for the proposed Infrastructure Master Plan for the San Francisco Zoological Gardens[12] indicates that the Fleishhacker Pool site vicinity is immediately underlain by artificial fill placed along the Great Highway between the Zoo and Lake Merced. In the vicinity of the Zoo, the thickness of the fill ranges from approximately two to over twenty feet. The fill is generally composed of sand, with occasional gravel, reworked from the wind-deposited sand dunes which blanket most of the Sunset District. The fill is underlain by loose to very dense dune sand with essentially no silt or clay. The thickness of the dune sands in the vicinity of the Zoo ranges from less than 10 feet to greater than 40 feet. The dune sand is underlain by very dense sand, silty sands, and clay of the Colma Formation, then sandstones of

[11] URS Consultants/John A. Blume and Associates, *San Francisco Seismic Safety Investigation,* June 1974.
[12] Kennedy/Jenks Consultants-AGS, Inc. An Association, 1995. Final Report, Infrastructure Geotechnical Study, Infrastructure Master Plan, San Francisco Zoological Gardens, San Francisco, California, June 1, 1995.

the Merced Formation. Franciscan Complex forms the bedrock in the area, approximately 600 to 1,000 feet beneath the surface. Shallow ground water at the Zoo is encountered at depths ranging from 5 to 40 feet. Much of the soil at this site, as determined by analytical testing, is classified as moderately corrosive.

Potentially liquefiable soils were encountered in an old drainage canal which connected Lake Merced to the ocean. The depth to the bottom of this zone ranges from 10 to 20 feet below ground surface. The geotechnical report prepared for this site concluded that if a structure is supported at least 20 feet below ground surface, it would not be underlain by liquefiable soils.

Lincoln High School - Reservoir Site and McCoppin Square Park - Staging Area

The Lincoln High School Reservoir site occupies the upper, northern portion of this site, and McCoppin Square staging area occupies the lower, southern portion. The entire site has been graded in bench configurations such that the Lincoln site is cut into the original topography and the McCoppin staging area is filled over the original topography. The Lincoln site is overlain by an athletic field at the surface, and the McCoppin site is overlain by a baseball field. There is a retaining wall along the southern boundary of the Lincoln site at Santiago Street up to approximately ten feet high. The wall was likely constructed to allow for the athletic field to extend on a level surface to the southern portion of the school campus.

The geology beneath the Lincoln site is estimated from nineteen borings drilled on the Lincoln High School Campus to the north.[13] Fill at the Lincoln site is comprised of three to 20 feet of loose to medium dense fill soils, primarily sands with varying fractions of clay and silt. The fill beneath the Lincoln site may thicken from the north to the south. Native soil below the fill generally consists of mixtures of sand and silt and clay.

The borings drilled to the north encountered bedrock at depths of one to 30 feet below the existing grade; no exposed bedrock is evident at the site. Bedrock was reported as relatively shallow (less than five feet from existing ground surface) near the western portion of the campus near the intersection of Rivera Street and 24th Avenue. The bedrock is at 50 feet or more beneath other portions of the site. Portions of the Lincoln High School campus are cut into native soils or sandstone/shale bedrock. The cut/fill contact between native material and fill is

[13] GeoResources Consultants, Inc., 1994. Geotechnical Review, Lincoln High School and McCoppin Square, August 15, 1994.

estimated to be near the northwestern portion of the campus. Local variations in the fill thickness and bedrock surface may exist. The clayey soils have a high shrink/swell potential.

The Lincoln site is located near the inactive City College fault zone. Rocks within this fault zone are likely to be sheared and possibly weaker than adjacent rocks. Previous investigations at this site indicated that groundwater may be present within the bedrock/soil contact. No long term groundwater monitoring is available for this site. If the groundwater level is at the rock surface, fill sand, such as that present at the Lincoln High School site, may be densified during strong seismic ground shaking.

Boring information is not available for the McCoppin Square site. It is estimated that over 25 feet of fill may have been placed at the staging area. The cut/fill contact for this site may be approximately 200 feet south of Santiago Street and trend in an east-west direction. At this site, liquefaction may occur below the water table and densification could occur above the water table. Current slope conditions may be stable. However, localized steep bedrock surfaces and groundwater conditions may affect the stability of the slope conditions.

The bearing material at the Lincoln High School site would likely be either naturally occurring or fill sand or bedrock. It is generally recommended that existing fill of unknown origin not be used for bearing support for a structure. The bearing capacity of the bedrock would likely be adequate for a structure such as a reservoir, provided that the same type of bedrock is present beneath the entire structure.

McLaren Park - Reservoir Site

No subsurface investigations have been conducted at the McLaren Park sites. Based on available information, the existing soils at the McLaren Park reservoir sites are likely a mixture of imported fill, residual soil, alluvium, and possibly landslide debris. Soils on these sites are predominantly clay, except where artificial fill has been added.[14] The slopes in the park are generally 10 to 25%. There are numerous areas of bare, eroded soils within the park. This condition exists between Sites 1 and 2. Clayey soils on steep slopes within the park if left bare of vegetation are susceptible to landslides.[15] Native and fill soils are likely shallow in the vicinity of Sites 1 and 2 due to the steep slopes that bound the sites to the south, and the number

[14] Geo/Resources Consultants, Inc., 1995. Geotechnical Review, John McLaren Park, June 23, 1995.
[15] ibid.

of rock outcrops visible on Site 1 and in road cuts on Site 2. Portions of Site 2 may be underlain by deeper fill. The boundaries of cut/fill are not known for these sites.

Bedrock beneath the McLaren Park reservoir sites is underlain by primarily sandstone, greenstone, and melange of the Franciscan complex.[16] Outcrops of greenstone and melange are visible at Site 1, where past grading has created cut slopes. At Site 2, sandstone is exposed in outcrops on the slopes south of Mansell Street. Bedrock of variable rippability may be expected near the surface at both sites. The slopes below each site appear slightly hummocky, which may indicate past slope movements

McLaren Park is approximately 2500 to 3000 feet north of the City College fault zone. The fault is mapped in a northwest–southwest direction between Sunnydale and Geneva avenues. Rocks within this fault zone are likely to be sheared and possibly weaker than adjacent rocks.

The bearing material at the McLaren Park sites would likely be either clay or bedrock; bedrock may be encountered at shallow depths and extensive fill may be encountered in the northern portion of Site 2. If the bedrock type present in the reservoir excavations is hard sandstone or greenstone, the bedrock would generally provide adequate bearing capacity although some settlement or heave could occur. However, if different bedrock types are present, then mitigation measure (see Chapter VIII, Measure E7) would be required to prevent differential settlement. The fill materials of unknown origin and any landslide debris would not provide an adequate bearing capacity for a reservoir. Clays beneath the site may allow differential settlement because of its variable thickness and plastic nature.

Slope conditions at the McLaren Park sites are generally considered stable for current soil, water, overburden, and topographic conditions. However, localized steep bedrock surfaces, attitudes of planer rock surfaces, rainfall, and groundwater conditions may affect the stability of slope conditions.

Groundwater monitoring and site specific geologic information are not available for either McLaren Park site. In general, soil densification or settlement could occur above the water table during strong seismic ground shaking; soils beneath the water table may also liquefy. The potential for densification and liquefaction is considered low if there is not a significant

[16] Geo/Resources Consultants, Inc., 1995. Geotechnical Review, John McLaren Park, June 23, 1995.

thickness of unconsolidated materials beneath the foundation of a structure, such as a reservoir, built at these sites.

The geotechnical report prepared for these sites concluded that either site would be an appropriate choice for construction of a reservoir. Site 2 offers a broader ridge and gentler slopes immediately below the site. Site 1 is located on a narrower ridge and a slope setback may be required.

GROUNDWATER MASTER PLAN PROJECT SITES

Elk Glen Well

The Elk Glen Well is an existing 360-foot deep irrigation well located in Golden Gate Park near the Elk Glen Lake. The site area is flat, landscaped, and underlain by imported fill soils. Beneath the imported fill materials used in the park, the geologic log for the well shows a thin mantle of imported soil underlain by a thin layer of dune sand which is underlain by a thick sequence of the Colma Formation. This formation consists of unconsolidated fine-to-medium-grained sand with small to moderate amounts of silt and clay. Bedrock is projected to be at approximately 400 feet below ground surface, about 40 feet deeper than the well. There is no site-specific geotechnical data on the Elk Glen Well; generalized geologic and seismic hazards for the area are presented in Table 18 (p. 197).

Sunset District Wells

The two proposed well sites in the Sunset District are located along a north-south line, separated from each other by about three-quarters of a mile. The sites are on the west-trending gentle slope down to the Pacific Ocean and have an elevation between 50 and 100 feet above mean sea level. The proposed pipelines from the wells would be installed to the east, up the slope to the existing 60-inch water main on 28th Avenue.

The Sunset District geology shows this part of the Westside Basin has a thick wedge of sediments beneath it with the thickest portion to the west. These deposits are over 500 feet thick near the ocean but decrease to less than 20 feet east of Sunset Boulevard. The two proposed well sites are located to the west of the City College sheer zone. Franciscan melange, consisting of sheared weathered shale and hard sandstone, is located in the eastern portion of the area east of the City College fault zone. The sites for the two wells are underlain by dune sand; Colma

Formation sand and silt, the friable sand, silt, and clay of the Merced formation; and bedrock of the Great Valley sequence.

The Sunset District area is crossed by the inactive San Bruno Fault and City College shear zone. The area is outside of the potential liquefaction zone that parallels the beach about four to five blocks to the west of the sites.[17] The sites are located on geologic materials that have a high capacity to amplify ground shaking.[18] No extensive damage was reported in this area as a result of the ground shaking experiences in the Loma Prieta earthquake.

Powell Street BART Station Dewatering System

The Powell Street BART Station dewatering well is located approximately 40 feet below the street level at the base of the BART station. The site is underlain by Bay muds and surface deposits of sand and silt to about 100 feet below ground surface, where Franciscan assemblage rocks are encountered. The Powell Street BART Station dewatering facility did not sustain any impacts from the 1989 Loma Prieta earthquake, and this site is mapped outside of the area of potential liquefaction. This site is located in an area predicted to experience "non-structural damage" on the Modified Mercalli intensity scale during an earthquake of magnitude 7.1 on the San Andreas Fault.[19]

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17 URS Consultants/John A. Blume and Associates. *San Francisco Seismic Safety Investigation,* June 1974.
18 ibid.
19 Association of Bay Area Governments, *The San Francisco Bay Area -- On Shaky Ground,* April 1995.

F. HAZARDOUS MATERIALS

The Hazardous Materials Setting presents an overview of the existing conditions at the project sites with respect to current and previous site conditions that could be associated with hazardous materials. It also presents a brief definition of hazardous materials and waste and a summary of the regulatory framework.

DEFINITION OF HAZARDOUS MATERIALS/WASTE

Hazardous materials are generally considered to be substances with certain chemical or physical properties which may pose a substantial present or future hazard to human health or the environment when improperly handled, stored, disposed or otherwise managed. In general, discarded or inherently waste-like hazardous materials are referred to as hazardous wastes. A material is a waste if it poses a threat to human health or the environment.[1] Hazardous materials and hazardous wastes are defined in the *California Code of Regulations*, Title 22, Sections 66260 through 66261.10. As defined in Title 22, hazardous materials are grouped into four general categories: toxic (causes human health effects); ignitable (has the ability to burn); corrosive (causes severe burns or damages materials); or reactive (causes explosions or generates toxic gases). A hazardous waste can be present in a liquid, semi-solid, solid, or gaseous form.

REGULATORY FRAMEWORK

Hazardous materials and hazardous wastes are extensively regulated by federal, state, regional and local regulations, with the major objective of protecting public health and the environment. In general, these regulations provide definitions of hazardous substances; identify responsible parties; establish reporting requirements; set guidelines for handling, storage, transport, remediation, and disposal of hazardous materials and wastes; and require health and safety provisions for both workers and the public, such as emergency response and worker training programs. Sites which are subject to these regulations are identified on periodically-updated published lists at the federal, state, and local levels; the regulated sites include underground storage tank locations.

The major agencies enforcing these regulations in San Francisco include: the U. S. Environmental Protection Agency (federal); the Department of Toxic Substances Control, California Environmental Protection Agency (state); the California Regional Water Quality

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1 *California Code of Regulations*, Title 22, Section 66261.2.

Control Board (state); the Bay Area Air Quality Management District (regional); and the San Francisco Department of Public Health, Toxics Health and Safety Services, Hazardous Waste Division (local).

HAZARDOUS MATERIALS/WASTE IN SOIL OR GROUNDWATER -- SITE REVIEW

A preliminary hazardous materials/waste site review was conducted for each of the proposed facility site locations associated with the RWMP and GWMP. The purpose of the site review is to determine the potential for hazardous or toxic compounds to be present in the soil or groundwater at a given site. This potential was based on three major criteria: (1) known presence of hazardous *wastes* to occur on-site, (2) known presence of hazardous *materials* to occur on-site, and (3) suspected presence of hazardous waste contamination on-site due to current, previous or adjacent land uses.

Approach to Hazardous Materials/Waste Site Review

A computerized record search was conducted for each of the proposed project sites and their vicinities to identify sites on published federal, state and regional regulatory lists as known or suspected hazardous materials and waste locations. In addition, evaluation of current and historical land uses at each site was determined by review of historical aerial photographs, Sanborn fire insurance maps, and site reconnaissance.

The known presence of hazardous waste contamination at a given site was determined by the actual listing of the proposed project site on any of the federal, state, regional or local agency lists or files regarding hazardous wastes. If a site appeared on any of these lists, then a review of that specific file indicated the type of contamination and the extent of investigation or remediation, and therefore the site-specific degree of potential impact to public health.

The known presence of hazardous materials to occur on-site was determined based on either the listing of the site as a hazardous materials generator or field observation of existing uses on-site. The presence of hazardous materials on-site does not necessarily imply hazardous wastes are present nor does it imply contamination of soil or groundwater.

To determine if a particular site was suspected to have the presence of hazardous waste contamination due to site usage or proximity to other nearby contaminated sites that could adversely affect the site in question involved a combination of field observations at the site, evaluation of existing and historical land uses at the site, and an evaluation of known or

suspected hazardous waste sites in the immediate vicinity of the site. Field observations at each site were conducted to identify the existing land use and to determine if hazardous materials or wastes are handled on-site as well as to observe any surface indication of hazardous waste contamination, such as soil staining, presence of possible hazardous materials storage containers, or any suspected debris or wastes that could contain hazardous wastes. Historical land uses at each of the proposed sites were examined to determine if any previous uses on-site (such as service stations) may have handled hazardous materials; this information was based on review of historical aerial photographs and Sanborn historical insurance maps. If hazardous materials are or were used on the site, then there is the potential for mishandling or improper disposal to have occurred and potential soil or groundwater contamination.

Results of Site Review

Table 19 summarizes the results of the hazardous materials site review for each proposed project site and includes a summary of current and historical uses and of sites listed on regulatory agency databases with known or suspected contamination. More detailed information is available in the *Hazardous Waste Background Report*.[2] With the exception of one service station one block from the RWMP pipeline, all of the sites listed on regulatory agency databases were generally greater than 1/4 mile from each of the proposed project sites, and they do not appear to have the potential for migration of contaminants to the project sites. The potential impacts of locating proposed project facilities near identified sites with known or suspected contamination is discussed in Section V.A.6, Hazardous Materials (pp. 307 to 313) and Section V.B.6, Hazardous Materials (pp. 414 to 417).

HAZARDOUS BUILDING MATERIALS

Based on the age of the Fleishhacker Bath House, hazardous building materials may be present within the structure. Certain materials or supporting fixtures associated with buildings can be potentially hazardous if not properly handled during the demolition or decommissioning of structures. The common types of building materials that require an environmental assessment are asbestos-containing building materials, lead-based paints, transformers which use polychlorinated biphenyls (PCB)-based oils, and mercury-containing lighting ballast. Other fixtures could also include underground or above ground storage tanks used to store hydrocarbons or chemicals and industrial process piping / air ducts.

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[2] Orion Environmental Associates, 1995. *Hazardous Waste Background Report for the Recycled Water Master Plan and Groundwater Master Plan.* Prepared for the San Francisco Department of Public Works and Water Department.

TABLE 19: SUMMARY OF HAZARDOUS MATERIALS / WASTE SITE REVIEW

Site	Current Use	Historical Uses	Record Search	Comments
Fleishhacker	Abandoned.	1925-1975, saltwater swimming pool & bath.	Site not listed. 1 former gas station with groundwater contamination within one block.	Former pool filled with construction debris, possibly abandoned cars; remediation completed at gas station site but groundwater contamination still present.
Lincoln High/ McCoppin Square	Athletic field and stadium since 1948.	~1938 possible industrial, storage, warehouse uses.	Site not listed. 5 listed sites within 1/2 mile.	Listed sites have no indication of groundwater contamination.
McLaren Park	Public park.	~1946, undeveloped with one main road and many dirt roads.	Site not listed. No listed sites within 1/2 mile.	
Pipeline Route from Fleishhacker to Lincoln High School to 19th Avenue	Paved roadways in primarily residential area.	1935, largely undeveloped. 1940s, residential and commercial development started.	Two sites listed with leaking underground tanks. One site directly on pipeline route and one site one block south of route.	Service station at 19th Avenue and Santiago on the pipeline route had low level contamination in soil only. Service station at 19th Avenue and Taraval one block south of route requires further investigation of soil and groundwater for petroleum hydrocarbon contamination.

TABLE 19: SUMMARY OF HAZARDOUS MATERIALS / WASTE SITE REVIEW (Continued)

Site	Current Use	Historical Uses	Record Search	Comments
Elk Glen well site	Existing well in Golden Gate Park.	Prior to 1935, Golden Gate Park.	1 listed site in Golden Gate Park about 1/2 mile away. 2 listed gas stations within 1/2 mile.	
Francis Scott Key School	School with paved playground.	~1933, undeveloped. ~1934, school built. ~1940, additions to school.	Site listed on RCRA. 2 listed gas stations within 1/2 mile.	Site listed on RCRA as small quantity generator, but no violations.
West Sunset Playground	Parking lot of public playground.	~1935, undeveloped. ~1954, playground and bleachers built. 1993, 6-in. well built.	Site not listed. No listed sites within 1/2 mile.	Groundwater samples taken at the site indicate no contamination.
Powell St. BART Station	Operating dewatering well in subway station.	1887, mixed use area including industrial uses. 1913, steam plant and varnishing/finishing fac. 1949, auto-related uses. 1960s-70s, BART built.	4 listed spill sites within 1/4 mile. 36 listed sites within 1/2 mile.	Tar Flat area south of Market suspected area of historical industrial contamination. Groundwater samples taken at the site indicate no contamination.

SOURCE: Orion Environmental Associates, 1995.

G. TRANSPORTATION AND CIRCULATION

REGIONAL

San Francisco is served by a number of regional serving roadways. Freeway access to and from the Peninsula is provided via U.S. 101, I-280, and State Route (SR) 1. Freeway access to the East Bay is provided via I-80 (Bay Bridge). Traffic headed to and from the North Bay generally travels along Van Ness Avenue to Lombard Street (U.S. 101).

The 1989 Loma Prieta earthquake had notable effects on the regional highway system (discussed in more detail, below); repairs to most facilities have yet to be completed, with the exception of the Bay Bridge, where one span of the upper deck collapsed during the earthquake. Repairs of the Bay Bridge were completed within one month, and operations on that bridge have returned to pre-earthquake patterns.

CITY OVERVIEW

Within San Francisco, major earthquake damage to State Route 480 (the Embarcadero Freeway), the I-280 extension north of U.S. 101, and the U.S. 101 ramps between Fell and Turk streets caused closure of these routes. The section of I-280 between Army and Fourth streets was repaired and has reopened. The section of I-280 between Army Street and U.S. 101 expanded from one lane in each direction to two lanes in each direction in July 1994, allowing traffic to connect to I-280 and U.S. 101 south of the U.S. 101/I-280 interchange. The full repair of I-280 between Army Street and U.S. 101 was completed in December 1995.[1]

Demolition of the elevated Embarcadero Freeway was completed in October 1991. In addition, the "terminal separator structure" (the elevated connector between the Bay Bridge and the Embarcadero Freeway) has been demolished. Alternatives to replacement of the Bay Bridge terminal separator and the mid-Embarcadero freeway are currently under study by the City; design alternatives include improvements to the Embarcadero Roadway, modifications to existing on- and off-ramps to the freeway, and a possible new freeway on-ramp.

Demolition of the section of U.S. 101 (the Central Skyway) north of the Oak/Fell on- and off-ramps was completed in 1992. This resulted in the removal of the Gough/Turk Streets on-ramp and the Franklin Street/Golden Gate Avenue off-ramp. The City commissioned a study

[1] Audrey Lewis, Public Information Assistant, telephone conversation, May 15, 1996.

of traffic in the area, and a report on the Central Freeway Areawide Traffic Study was published in August 1994. No preferred plans have been selected for changed access to the Central Freeway. The City is currently reviewing plans for Caltrans to perform retrofitting for seismic strengthening on the section of U.S. 101 between Mission Street and Fell Street.

The San Francisco Transportation Authority will soon commence a preliminary study for the replacement of Doyle Drive, an elevated freeway structure which provides access to the Golden Gate Bridge.

RECYCLED WATER MASTER PLAN PROJECT SITES

Once implemented, the Recycled Water Master Plan components would not generate a measurable amount of traffic; vehicle trips would primarily be associated with on-going maintenance and repair of these facilities. Thus, this discussion focuses on construction-related transportation and circulation issues.

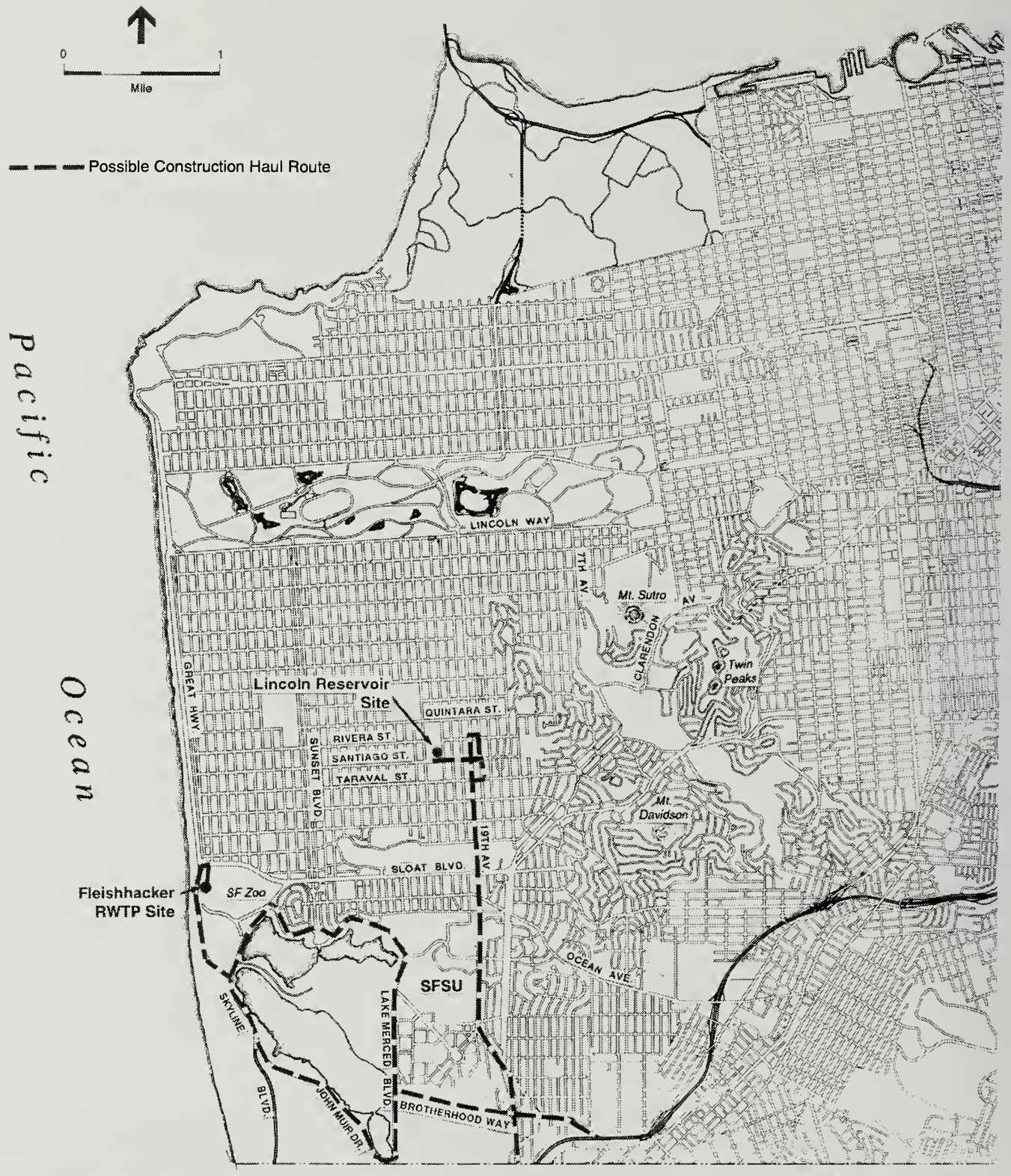
Recycled Water Treatment Plant - Fleishhacker Pool Site

Roadway Network

The Recycled Water Treatment Plant (RWTP) site is located in the northwestern corner of the grounds of the San Francisco Zoological Gardens, located off Sloat Boulevard. Two alternative construction access points to the RWTP site are proposed: a north access point off Sloat Boulevard (at 47th Avenue), and a west access point off the Great Highway.

It is assumed that I-280 would serve as the primary regional route to access the project site, given the proximity of this route to the site, and its ease of connection to other regional routes. This assumes that most construction traffic would travel between the project sites in San Francisco and locations in the East Bay or South Bay, where major construction material supply centers and disposal sites are located. Conversely, it assumes that little, if any, construction traffic would travel to and from Marin County.

It is expected that the haul route used to access the RWTP site during construction would be as follows (see Figure 56): I-280 to Brotherhood Way (via Sagamore Street from northbound I-280; or via SR 1 from southbound I-280), Lake Merced Boulevard or John Muir Drive to



SOURCE: Environbmental Science Associates

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Figure 56
Fleishhacker RWTP Site
and Lincoln Reservoir Site –
Possible Construction Haul Routes

Skyline Boulevard, Skyline Boulevard to the Great Highway, and the Great Highway to either the proposed west access point or Sloat Boulevard to the proposed north access point.

Sloat Boulevard is a six-lane, divided roadway that extends east-west, providing access to the Great Highway, Skyline Boulevard (SR 35), Sunset Boulevard and 19th Avenue. Along the proposed haul route, Sloat Boulevard is designated as a secondary arterial in the *San Francisco General Plan*.[2] The maximum posted speed limit on Sloat Boulevard is 40 miles per hour (mph). Skyline Boulevard is four-lane divided arterial that extends south from Sloat Boulevard, providing access to the Peninsula. Along the proposed haul route, Skyline Boulevard is a designated as a major arterial in the City's *General Plan*.[3] The maximum posted speed limit on Skyline Boulevard is 45 mph.

The Great Highway extends north from Skyline Boulevard along the Pacific Ocean. The Great Highway is designated as a recreational street in the City's *General Plan*.[4] Along the proposed haul route, the Great Highway is a divided four-lane roadway with a maximum posted speed limit of 35 mph. Lake Merced Boulevard in the City's *General Plan*, provides access around the northern and eastern side of Lake Merced. East of Sunset Boulevard, Lake Merced Boulevard is a four-lane divided roadway, and designated as a secondary arterial in the *San Francisco General Plan*; west of Sunset Boulevard, Lake Merced Boulevard is a two-lane roadway. The maximum posted speed limit on Lake Merced Boulevard is 45 mph. John Muir Drive is a two-lane roadway connecting Lake Merced Boulevard and Skyline Boulevard along the southwest portion of Lake Merced; it is designated as a recreational street in the City's *General Plan.*

Brotherhood Way is a four-lane divided arterial that extends east from Lake Merced Boulevard, providing direct access to SR 1. Brotherhood Way ranges from a a major to secondary arterial in the City's *General Plan*. The maximum posted speed limit on Brotherhood Way is 45 mph. Sagamore Street is a five-lane divided arterial (3 lanes westbound, 2 lanes eastbound) that serves to channel traffic to and from I-280. The maximum posted speed limit on Sagamore Street is 30 mph.

Traffic volumes on various major roadways described above are presented in Table 20.

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2 The *San Francisco General Plan* identifies secondary arterials as intra-district routes of varying capacity serving as collectors for the major thoroughfares; in some cases supplemental to the major street system.

3 The *San Francisco General Plan* identifies major arterials as crosstown thoroughfares whose primary function is to link districts within the city and distribute traffic from and to the freeways; these are routes generally of citywide significance; of varying capacity depending on the travel demand for the specific direction and adjacent land uses.

4 The *San Francisco General Plan* identifies recreational streets as a special category of streets whose major function is to provide for slow pleasure drives, as well as cyclist and pedestrian use; more highly valued for recreational use than for traffic movement.

TABLE 20: EXISTING DAILY TRAFFIC VOLUMES ON MAJOR PROJECT AREA ROADWAYS /a/

Roadway	Location	Daily Traffic (vpd) /b/
Geary Street	at 37th Avenue	15,000
Crossover Drive (SR 1)	north of Lincoln Boulevard	78,000
19th Avenue (SR 1)	north of Quintara Street	79,000
19th Avenue (SR 1)	south of Sloat Boulevard	78,000
19th Avenue (SR 1)	north of Junipero Serra Boulevard	63,000
Junipero Serra Boulevard	north of 19th Avenue	30,000
Sloat Boulevard	between Great Highway and Skyline Blvd.	12,000
Sloat Boulevard (SR 35)	between Sloat Blvd. and Sunset Blvd.	24,300
Sloat Boulevard (SR 35)	west of 19th Avenue	25,500
Lake Merced Boulevard	north of Brotherhood Way	38,300
Brotherhood Way	west of Alemany Street	25,000
Skyline Boulevard (SR 35)	south of Sloat Boulevard	19,000
Skyline Boulevard (SR 35)	south of John Muir Drive	28,000
Alemany Boulevard	south of Geneva Street	16,500
Mission Street	south of Geneva Street	21,000
Geneva Street	east of Mission Street	25,000
Bayshore Boulevard	north of Mansell Street	16,000
Mansell Street	west of U.S. 101	5,800

/a/ Volumes from City of San Francisco Department of Parking and Traffic, *24-Hour Traffic Counts*, 1989-1994; Caltrans, *1994 Traffic Volumes on California State Highways*, 1995.
/b/ vpd = vehicles per day

SOURCE: Caltrans, 1994; City of San Francisco, 1995.

Transit Service

Transit service in the project area is provided by San Francisco Municipal Railway (MUNI). The San Mateo County Transportation Authority (SamTrans) also has routes that extend through the project area. Sloat Boulevard, Skyline Boulevard, and Lake Merced Boulevard serve as major cross-town bus routes. Roads used by MUNI or other bus lines that would be potentially affected by implementation of the RWMP and GWMP (due to construction activity to/from the project sites) are presented in Table 21.

Bicycle/Pedestrian Circulation

Along the proposed haul route, the *San Francisco General Plan* identifies Skyline Boulevard, Lake Merced Boulevard and John Muir Drive as containing bicycle paths, and designates the Great Highway, Brotherhood Way (east of SR 1) and Sagamore Street as citywide bicycle routes.[5] Sloat Boulevard, Skyline Boulevard, Lake Merced Boulevard, Brotherhood Way and Sagamore Street contain pedestrian walkways (sidewalks).

Lincoln High School - Reservoir Site and McCoppin Square Park - Construction Staging Area

Roadway Network

The Lincoln High School reservoir site and McCoppin Park staging area, as well as proposed access points to these sites, are located off Santiago Street. It is expected that the haul route used to access the Lincoln High School site during construction would be as follows (see Figure 38, p. 122 and Figure 41, p. 131): I-280 to 19th Avenue (directly from southbound I-280 or via Sagamore Street and Brotherhood Way from northbound I-280), 19th Avenue, and to the sites via a combination of either: Rivera Street, 18th Avenue, and Santiago Street; or Taraval Street, 18th Avenue, and Santiago Street.

19th Avenue (SR 1), a six-lane divided arterial designated as a major arterial in the *San Francisco General Plan*, serves as the primary north-south access route through the Sunset District. Left turns from 19th Avenue are prohibited in the project area. The maximum posted

[5] Bicycle paths, otherwise known as Class I bikeways, are dedicated paths separated from auto traffic. The citywide bicycle routes generally consist of Class II and Class III bikeways. A Class II bikeway is a striped and signed lane on a roadway, and a Class III bikeway is a signed route on a roadway without a striped lane.

TABLE 21: TRANSIT LINES OPERATING ON POTENTIALLY AFFECTED ROADWAYS IN THE PROJECT AREA

Transit Line /a/	Roadway	Peak Headways AM/PM /b/
6 - Parnassus	Quintara Street	9/9
9 - San Bruno	San Bruno Avenue	8/8
9X - San Bruno	San Bruno Avenue	12/9
9AX - San Bruno Express	San Bruno Avenue	10/8
16AX - Noriega Express	Sunset Boulevard	10/15
17 - Parkmerced	19th Avenue	20/20
18 - 46th Avenue	19th Avenue, Sloat Boulevard, Skyline Boulevard, Lake Merced Boulevard	15/15
23 - Monterey	Sloat Boulevard	15/15
26 - Valencia	Brotherhood Way, 19th Avenue, Sagamore Street	15/15
28 - 19th Avenue	SR 1, 19th Avenue	10/11
28L - 19th Avenue Limited	SR 1, 19th Avenue	Weekday school hours only
29 - Sunset	Paul Avenue, Mansell Street, 19th Avenue, Sunset Boulevard, Lake Merced Boulevard	15/14
48 - Quintara-24th Street	39th Avenue, Rivera Street, Santiago Street, Quintara Street	12/12
54 - Felton	19th Avenue, Sagamore Street	20/20
56 - Rutland	Mansell Street, San Bruno Avenue	30/30
66 - Quintara	15th Avenue, 16th Avenue, 30th Avenue, Quintara Street	20/20
88 - BART Shuttle	Lake Merced Boulevard, Brotherhood Way, Sagamore Street	16/10
L - Taraval (Metro)	Taraval Street	5/6
M - Ocean View (Metro)	19th Avenue, Taraval Street	10/12
SamTrans 3B	SR 1, 19th Avenue	60/60
SamTrans 7B	Bayshore Boulevard	30/30
SamTrans 21A	Lake Merced Boulevard	30/30

/a/ All transit lines are MUNI lines, except as noted.
/b/ Peak headway is the scheduled time in minutes between transit vehicles during the a.m. and p.m. peak periods.

SOURCE: Environmental Science Associates, compiled from *San Francisco Municipal Railway Street and Transit Map*, 1994; and *SamTrans Bus System Route Map*, 1995.

speed limit on 19th Avenue is 35 mph. Rivera Street, Santiago Street, and 18th Avenue are two-lane residential streets. Taraval Street is a two-lane neighborhood commercial street. East of 19th Avenue, Taraval Street is designated as a secondary arterial in the City's *General Plan.*

Traffic volumes on various major roadways described above are presented in Table 20 (p. 213).

Transit Service

19th Avenue serves as a major crosstown bus route. Taraval Street is designated as a primary transit oriented street in the City's *General Plan.*[6] Roads used by MUNI or other bus lines that would be potentially affected by implementation of the RWMP and GWMP (due to construction traffic) are presented in Table 21 (p. 215).

Bicycle/Pedestrian Circulation

Along the proposed haul route, the *San Francisco General Plan* designates Brotherhood Way and Sagamore Street as citywide bicycle routes (defined in Footnote 4, p. 212). Brotherhood Way, Sagamore Street, 19th Avenue, 18th Avenue, Rivera Street, Santiago Street and Taraval Street contain pedestrian walkways.

McLaren Park - Reservoir Site

Roadway Network

The two McLaren Park alternative reservoir sites and proposed construction access points to these sites are located off John F. Shelley Drive in McLaren Park. It is expected that the haul route used to access these reservoir sites during construction would be as follows (see Figure 57): U.S. 101 to Mansell Street (directly from southbound U.S. 101 or via Bayshore Boulevard, Paul Avenue, and San Bruno Avenue from northbound U.S. 101), and Mansell Street to John F. Shelley Drive.

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6 The *San Francisco General Plan* identifies primary transit oriented streets as important streets for transit operations. These streets are not major arterials; the transit operating on these roadways contain high transit ridership, or high frequency of service, or surface rail.

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SOURCE: Environmental Science Associates

Figure 57
McLaren Park Reservoir Sites -
Possible Construction Haul Routes

John F. Shelley Drive is a two-lane loop roadway that winds through the northern section of McLaren Park. The maximum posted speed limit on John F. Shelley Drive is 25 mph. Mansell Street is a two- to four-lane arterial extending west from U.S. 101 and it provides access to and through McLaren Park. The maximum posted speed limit on Mansell Street ranges between 25 and 45 mph. Bayshore Boulevard is a four-lane divided arterial that travels just east of and parallel to U.S. 101. Bayshore Boulevard is designated as a major arterial in the City's *General Plan*. The maximum posted speed limit on Bayshore Boulevard is 35 mph. Paul Avenue is a four-lane roadway that provides access underneath U.S. 101. San Bruno Avenue extends just west of and parallel to U.S. 101. Along the proposed haul route, San Bruno Avenue is two lanes northbound and one lane southbound. The maximum posted speed limit on San Bruno Avenue is 25 mph.

Traffic volumes on various major roadways are described above is presented in Table 20 (p. 213).

Transit Service

Mansell Street and Paul Avenue serve as major crosstown bus routes. San Bruno Avenue is designated as a secondary transit street in the *San Francisco General Plan*.[7] Roads used by MUNI or other bus lines that would be potentially affected by implementation of the RWMP and GWMP (due to construction traffic) are presented in Table 21 (p. 215).

Bicycle/Pedestrian Circulation

Along the proposed haul route, the *San Francisco General Plan* designates Bayshore Boulevard as a citywide bicycle route. The *General Plan* designates Mansell Street as a neighborhood network connection street, and San Bruno Avenue as a neighborhood commercial street.[8] Bayshore Boulevard, Paul Avenue, San Bruno Avenue, and the section of Mansell Street between San Bruno Avenue and McLaren Park contain pedestrian walkways (sidewalks).

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7 The *San Francisco General Plan* identifies secondary transit streets as having transit operations containing medium transit ridership and low-to-medium frequency of service; or medium frequency of service and low-to-medium transit ridership; or connecting two major destinations.

8 The *San Francisco General Plan* defines neighborhood network connection streets as intra-neighborhood connection streets that connect neighborhood destinations, and neighborhood commercial streets as serving predominantly commercial use with parking and loading conflicts.

Transmission Lines Connecting Recycled Water Treatment Plant and Lincoln High School Reservoir Site

Roadway Network

The proposed transmission lines connecting the Fleishhacker RWTP site with the Lincoln High School reservoir site are as follows: one segment would extend north from the treatment plant east along Sloat Boulevard, north along 45th Avenue to Santiago Street, and then east on Santiago Street, and to the reservoir site at 22nd Street.

Santiago Street is a two-lane roadway with a roadway width of 50 feet (curb-to-curb). 45th Avenue is a two-lane roadway with a roadway width of 40 feet. Parking is permitted along both sides of these roadways.

Transit Service

Along the proposed alignment, Sloat Boulevard, Sunset Boulevard, Quintara Street, and 19th Avenue serve as major crosstown bus routes. Roads used by MUNI or other bus lines that the proposed pipeline would extend along or across are presented in Table 21 (p. 215).

Bicycle/Pedestrian Circulation

The proposed alignment would cross four roadways designated in the City's *General Plan* as citywide bicycle routes: Sloat Boulevard, Vicente Street, Thirty-Fourth Avenue, and Twentieth Avenue (classes of bikeways are defined in Footnote 4, p. 212). All roadways in which the proposed pipeline would extend along or across contain pedestrian walkways.

Other Transmission and Distribution Pipeline Corridors

Other transmission and distribution pipeline corridors related to the Fleishhacker RWTP site and the Lincoln and McLaren Park reservoir sites would run through a variety of San Francisco districts including the Outer Richmond, Golden Gate Park, Outer Sunset, Parkside, Lakeshore, Ocean View, Outer Mission, Excelsior, Visitacion Valley and Bayview districts (see Figure 35, p. 114). The pipelines would extend primarily through residential areas, and, to a lesser degree, through commercial areas and public property (including school, Zoo, and park properties). To the degree possible, pipelines would be constructed beneath roads, reducing impacts to surrounding land uses.

Specific pipeline alignments would not be developed until a later time; thus, a general description of potential roadways within each district that could be affected by pipeline construction is provided below. Traffic volumes on various major and secondary thoroughfares that could be affected by pipeline construction are presented in Table 20 (p. 213).

Outer Richmond District

Major arterials within the Outer Richmond District that could be affected by proposed pipeline construction include Geary Boulevard (four-lane arterial) and Park Presidio (six-lane arterial); secondary arterials include Fulton Street, Balboa Street and California Street (two-lane arterials). These roadways also serve as transit corridors. The majority of other roadways within the proposed pipeline corridor in the Outer Richmond District are residential, two-lane roadways with curb-to-curb roadway widths ranging from 40 to 50 feet.

Golden Gate Park District

The most heavily trafficked and major transit roadway that could be affected by pipeline construction within Golden Gate Park is Cross Over Drive (major, six-lane divided arterial), which serves to channel SR 1 traffic through the Park. Other internal Park roadways that could be affected by pipeline construction include two-lane roadways generally ranging in width from 32 to 40 feet.

Outer Sunset / Parkside Districts

Major arterials that could be affected by the pipeline installation within these districts include Lincoln Boulevard (four-lane arterial), Sloat Boulevard and 19th Avenue (six-lane arterials); secondary arterials include Sunset Boulevard (six-lane arterial). These roadways, Taraval Street, Noriega Street and Judah Street, and Quintara Street also serve as major transit corridors. The majority of other roadways within the proposed pipeline corridor in the Outer Sunset and Parkside districts are residential, two-lane roadways with curb-to-curb widths ranging from 40 to 50 feet.

Lakeshore District

Major arterials that could be affected by the pipeline construction within the Lakeshore District include: Skyline Boulevard (four-lane arterial), 19th Avenue and Junipero Serra Boulevard (six-lane arterials). The majority of other roadways within the proposed pipeline corridor in the

Lakeshore District located north of Lake Merced are residential two-lane roadways approximately 34 to 40 feet wide. East of San Francisco State University, the residential, two-lane roadways have narrower widths (approximately 26 feet).

Ocean View District

Major thoroughfares that could be affected by pipeline installation within the Ocean View District include: Brotherhood Way (four-lane arterial), and Sagamore Street (five-lane arterial) The majority of other roadways within the proposed pipeline corridor in the Ocean View District are residential two-lane roadways approximately 30 feet wide. The major transit corridors within this district that could be affected include 19th Avenue, San Jose Avenue, Broad Street, Randolph Street, and Sagamore Street.

Outer Mission / Crocker Amazon / Excelsior Districts

Major arterials that could be affected by pipeline installation within these districts include: Geneva Street (four-lane arterial) and Alemany Street (six-lane arterial). These roadways, and Mission Street (four-lane arterial) serve as major transit corridors. The majority of other roadways within the proposed pipeline corridor in these districts are residential, two-lane roadways approximately 30 feet wide.

Visitacion Valley / Bayview Districts

Major arterials that could be affected by pipeline installation within these districts include Bayshore Boulevard and Third Street (four-lane arterial); secondary arterials include Silver Avenue (two-lane arterial). The majority of residential roadways within the proposed pipeline corridor in the Visitacion Valley and Bayview districts consist of two-lane roadways, approximately 34 to 40 feet wide. Other roadways along the proposed pipeline corridor within these districts are wider, including Mansell Street, Harney Way, Jamestown Avenue, Gilman Street, and Hunters Point Expressway, with travel widths of 50 to 70 feet. Major transit corridors in these districts that could be affected by pipeline construction include Visitacion Avenue, San Bruno Avenue and Third Street.

GROUNDWATER MASTER PLAN PROJECT SITES

Elk Glen Well and Associated Pipelines

Roadway Network

Elk Glen Well is located on the northeast side of Elk Glen Lake in Golden Gate Park, along Transverse Drive (see Figure 30, p. 98). The proposed pipeline associated with the Elk Glen Well would extend approximately 200 feet east from the well, tying into an existing pipeline located in Transverse Drive. Transverse Drive, a two-lane park roadway, is designated as a recreational street in the *San Francisco General Plan*.

Transit Service

No MUNI transit lines would cross the proposed pipeline alignment.

Bicycle/Pedestrian Circulation

Transverse Drive contains pedestrian walkways along both sides of the roadway.

Sunset District Wells and Associated Pipelines

Roadway Network

The proposed sites are located at Francis Scott Key School and West Sunset Playground, on Kirkham and Quintara Streets, respectively. Francis Scott Key School is bounded by 42nd and 43rd avenues and Kirkham and Lawton streets. The pipeline associated with the well at this school would extend from the northeast corner of the playground, eastward on Kirkham Street to an existing pipeline in 28th Avenue. West Sunset Playground is located at 41st Avenue and Quintara Street. The pipeline associated with the well at this site would extend from the southwest corner of the park, eastward on Quintara Street to 39th Street, southward on 39th Street to Rivera Street, and then eastward on Rivera Street to 30th Street (see Figure 30, p. 98).

All roadways which could be affected by the proposed GWMP pipelines are two-lane residential roadways. Kirkham, Moraga, Quintara, and Rivera streets each have a roadway width of 50 feet, while 39th and 44th Avenues each have a roadway width of 40 feet. Parking is permitted along both sides of these roadways. The largest roadway the proposed pipelines would cross is Sunset Boulevard (six-lane arterial).

Transit Service

Roads used by MUNI or other bus lines that the proposed pipelines would extend along or across are presented in Table 21 (p. 215). These include Sunset Boulevard, sections of Quintara Street, 39th Avenue, Rivera Street, and 30th Avenue, which serve as major crosstown bus routes.

Bicycle/Pedestrian Circulation

The proposed pipeline alignments would cross Thirty-Fourth Avenue, designated in the City's *General Plan* as a citywide bicycle route; in addition, the Francis Scott Key School pipeline would extend along Kirkham Street, also designated as a citywide bicycle route (classes of bikeways are defined in Footnote 4, p. 212). All roadways in which the proposed pipelines would extend along or across contain pedestrian walkways.

H. AIR QUALITY

CITY OVERVIEW

Meteorology

The Bay Area's climate, as with all California coastal environs, is dominated by the strength and position of the semi-permanent high pressure center over the Pacific Ocean near Hawaii. It creates cool summers, mild winters, and infrequent rainfall; it drives the cool daytime sea breeze and maintains comfortable humidities and ample sunshine. Temperatures in the San Francisco area average 58 degrees Fahrenheit annually, ranging from the mid-40s on winter mornings to the mid-70s in late summer afternoons. The strong onshore flow of wind in summer keeps cool air and frequent cloudiness over the Bay Area until September when the offshore Pacific high pressure center weakens and migrates southward. Warmest temperatures generally occur in September and October. Temperature extremes, reaching 90 degrees or dropping to freezing, are rare in San Francisco. Rainfall in San Francisco averages 18 inches per year and is confined primarily to the "wet" season from late October to early May. Except for occasional light drizzles from thick marine stratus clouds, summers are almost completely dry.

Winds in the San Francisco area display several characteristic regimes. During the day, especially in summer, winds are from the southwest/west at 10 to 14 miles per hour as air is funneled through the Golden Gate. At night, especially in winter, the land becomes cooler than the water and an offshore flow off the hills develops over portions of the area. In San Francisco, however, the marine intrusion is so strong that the onshore flow persists both day and night during the warmer months. On the west side of San Francisco in both winter and summer, the background pollution upwind of the project area is generally sufficiently low such that the project area experiences excellent air quality and rarely exceeds clean air standards.

Ambient Air Quality Standards

The Clean Air Act Amendments of 1970 established national ambient air quality standards, and individual states retained the option to adopt more stringent standards and to include other pollution species. California had already established its own air quality standards when federal standards were established, and because of the unique meteorological problems in the state, there is considerable diversity between state and federal standards currently in effect in California, as shown in Table 22.

TABLE 22: CALIFORNIA AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	SAAQS /a,c/	NAAQS /b,c/
Ozone	1 hour	0.09 ppm	0.12 ppm
Carbon Monoxide	1 hour	20 ppm	35 ppm
	8 hour	9.0 ppm	9 ppm
Nitrogen Dioxide	1 hour	0.25 ppm	NA
	Annual	NA	0.053 ppm
Sulfur Dioxide	1 hour	0.25 ppm	NA
	3 hour	NA	0.5 ppm
	24 hour	0.04 ppm	0.14 ppm
	Annual	NA	0.03 ppm
Respirable Particulate Matter	24 hour	50 ug/m^3	150 ug/m^3
	Annual	30 ug/m^3	50 ug/m^3
Sulfates	24 hour	25 ug/m^3	NA
Lead	30 day	1.5 ug/m^3	NA
	Calendar Quarter	NA	1.5 ug/m^3
Hydrogen Sulfide	1 hour	0.03 ppm	NA
Vinyl Chloride	24 hour	0.010 ppm	NA

/a/ SAAQS stands for State Ambient Air Quality Standards (California). SAAQS for ozone, carbon monoxide, sulfur dioxide (1-hour and 24-hour), nitrogen dioxide, and respirable particulate matter are values that are not to be exceeded. All other California standards shown are values not to be equaled or exceeded.

/b/ NAAQS stands for National Ambient Air Quality Standards. NAAQS, other than ozone and those based on annual averages, are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is equal to or less than one.

/c/ ppm = parts per million by volume; ug/m3 = micrograms per cubic meter; NA = Not Applicable

SOURCE: California Air Resources Board, *California Air Quality Data Summary*, 1992.

The ambient air quality standards are intended to protect the public health and welfare and they incorporate an adequate margin of safety. They are designed to protect those segments of the public most susceptible to respiratory distress, known as sensitive receptors, such as asthmatics, the very young, the elderly, people weak from other illness or disease, or persons engaged in strenuous work or exercise. Healthy adults can tolerate occasional exposure to air pollution levels somewhat above the ambient air quality standards before adverse health effects are observed.

Ambient Air Quality

The Bay Area Air Quality Management District (BAAQMD) operates a regional monitoring network which measures the ambient concentrations of six criteria air pollutants: ozone (O_3), carbon monoxide (CO), fine particulate matter (PM_{10}), lead (Pb), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2). The San Francisco air basin was redesignated in June 1995 as an "attainment" area for the federal O_3 standard. The air basin is currently being considered for redesignation as an "attainment" area for the federal CO standard, since it has met the criteria for redesignation. San Francisco occasionally experiences violations of California eight-hour CO and PM_{10} standards, but has not recently violated the O_3 standard.

Existing and probable future levels of air quality in the City can be generally inferred from ambient air quality measurements conducted by the Bay Area Air Quality Management District (BAAQMD) at its two San Francisco monitoring stations. The Potrero Hill station at 10 Arkansas Street measures all criteria pollutants, including regional pollution levels (O_3), as well as primary vehicular emission levels near busy roadways (CO). The station at 939 Ellis Street at BAAQMD headquarters measures only carbon monoxide. Table 23 summarizes the last six years of published data (1989 to 1994) from these monitoring stations. During this six-year period, there were no violations of the one-hour or eight-hour CO standards at the Arkansas Street monitoring station. The California PM_{10} standard was violated 6 days out of 61 measurement days in 1994; during 1993, the PM_{10} standard was violated 5 days out of 61 measurement days. The CO standard has not been violated since 1988.[1] O_3, NO_2 and particulate sulfate measurements are within allowable maximum concentrations.

[1] California Air Resources Board, *Air Quality Data Summaries,* 1989-1994.

TABLE 23: SAN FRANCISCO AMBIENT AIR QUALITY MONITORING SUMMARY, 1989 - 1994

Pollutant	Standard	Number of Days Standards Were Exceeded and Maximum Concentration Measured /a/ 1989	1990	1991	1992	1993	1994
Ozone							
1-Hour	> 0.09 ppm	0	0	0	0	0	0
1-Hour	> 0.12 ppm	0	0	0	0	0	0
Max. 1-Hour Conc. (ppm)		0.08	0.06	0.05	0.08	0.08	0.06
Carbon Monoxide (Arkansas station)							
1-Hour	> 20. ppm	0	0	0	0	0	0
8-Hour	> 9. ppm	0	0	0	0	0	0
Max. 1-Hour Conc. (ppm)		9	8	9	8	7	6
Max. 8-Hour Conc. (ppm)		7.0	5.6	6.5	6.4	5.1	4.5
Carbon Monoxide (Ellis station)							
1-Hour	> 20. ppm	0	0	0	0	0	0
8-Hour	> 9. ppm	0	0	0	0	0	0
Max. 1-Hour Conc. (ppm)		14	12	14	10	10	8
Max. 8-Hour Conc. (ppm)		9.0	6.9	8.4	7.4	6.9	5.4
Nitrogen Dioxide							
1-Hour	> 0.25 ppm	0	0	0	0	0	0
Max. 1-Hour Conc.(ppm)		0.14	0.11	0.10	0.09	0.08	0.09
Inhalable Particulates (PM_{10})							
24-Hour	> 50 $\mu g/m^3$	13/62	12/61	15/60	9/61	5/61	6/61
24-Hour	> 150 $\mu g/m^3$	0/62	1/61	0/60	0/61	0/61	0/61
Max. Daily Conc. ($\mu g/m^3$)		101	165	109	81	69	93
Particulate Sulfate							
24-Hour	> 25 $\mu g/m^3$	0/61	0/61	0/60	0/61	0/56	0/61
Max. 24-Hr. Conc. ($\mu g/m^3$)		13.3	8.9	7.9	18.2	12.4	13.9

/a/ x/y indicates that standards were exceeded on x days out of a total of y days on which measurements were taken that year.

conc. = concentration; ppm = parts per million; $\mu g/m^3$ = micrograms per cubic meter

SOURCE: California Air Resources Board, *Air Quality Data Summaries,* 1989-1994. BAAQMD Monitoring Stations, 10 Arkansas Street and 939 Ellis Street.

Comparison of these data with those from other BAAQMD monitoring stations indicates that San Francisco's air quality is among the least degraded of all developed portions of the Bay Area Air Basin (BAAB). Three of San Francisco's four prevailing winds, west, northwest, and west-northwest, blow from the Pacific Ocean, reducing the potential for San Francisco to receive air pollutants from elsewhere in the region.

Data from air quality monitoring in San Francisco show that there have been occasional local exceedences of California and federal CO and PM_{10} standards, largely due to air pollutant emissions from within the City. CO is a non-reactive air pollutant, the major source of which is motor vehicles. CO concentrations are generally highest during periods of peak traffic congestion. The primary sources of particulates (PM_{10}) in San Francisco are construction and demolition activities, combustion of fuels for heating, and vehicle travel over paved roads.[2] Airborne dust levels measured in San Francisco show occasional violations of the California PM_{10} (inhalable-or respirable-sized particles) standards, and maximum PM_{10} levels have declined over the six-year period shown in Table 23 (p. 227). In general, particulate levels are relatively low near the coast, increase with distance from the coast, and peak in dry, sheltered valleys. One federal standard violation occurred in 1990; federal guidelines allow for no more than one violation per year averaged over a three-year period in defining a "non-attainment" area.

Monitoring data suggest that limited additional emissions could be accommodated within localized City micro-environments as long as the magnitude of the localized increases is not overly severe.

Air Quality Planning

The 1977 Clean Air Act required that regional planning and air pollution control agencies prepare a regional Air Quality Plan to outline the measures by which both stationary and mobile sources of pollutants can be controlled in order to achieve all standards within the deadlines specified in the Clean Air Act. For the BAAB, the Association of Bay Area Governments (ABAG), the Metropolitan Transportation Commission (MTC), and the BAAQMD jointly prepared a *Bay Area Air Quality Plan* in 1982 which predicted attainment of all national clean air standards within the basin by 1987. This forecast was somewhat optimistic in that attainment of federal clean air standards did not occur throughout the entire air basin until 1991.

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[2] BAAQMD, *Air Quality Handbook*, 1991 Bay Area Average Emissions by Source Category, Appendix IV, 1993.

A request for redesignation of the air basin as an "attainment area" for ozone and carbon monoxide has been made to USEPA. The formal designation of the Bay Area Air Basin as an attainment area for the federal ozone standard was made in June 1995. The attainment designation for carbon monoxide has not yet been received although it has met the criteria for redesignation. For PM_{10}, the basin is "unclassified" at present, awaiting a possible revision of PM_{10} standards to include only very fine particulate matter (≤ 2.5 $\mu g/m^3$). Relative to state standards, the basin is non-attainment for ozone, the eight-hour CO standard, and the PM_{10} standard.

The 1989 California Clean Air Act (AB-2595) requires development of air quality plans and strategies to reduce O_3 and CO levels in the Bay Area. As a result, a *Bay Area Clean Air Plan* was prepared in 1991, which mandates a 5 percent per year air quality improvement. Attainment of California air quality standards in the Bay Area has not yet occurred, since emissions reductions required by the *1991 Clean Air Plan* are partially offset by new emissions from population and industry growth in the basin.

The *1991 Clean Air Plan* contains specific measures aimed to reduce indirect sources of emissions, including transportation control measures designed to reduce the contribution of the automobile, the single-most important contributor to degraded air quality. Any project which attracts automobile traffic may have a significant air quality impact if the traffic level has not been properly anticipated in the regional air quality plan.

RECYCLED WATER MASTER PLAN PROJECT SITES

Recycled Water Treatment Plant - Fleishhacker Pool Site

The Westside Pump Station is located immediately west of the Fleishhacker site. In February 1992, a PM_{10} monitor was installed at the Westside Pump Station as part of the mitigation monitoring program for the Lake Merced Transport construction project. Prior to that, PM_{10} was monitored at two sites to the east (downwind) of the Fleishhacker RWTP site as part of the mitigation monitoring program for the Oceanside Water Pollution Control Plant construction. Between 1989 and 1994, PM_{10} was monitored at Fort Funston (south of the site) and was used as the upwind control monitor for both projects. Both monitoring programs focused on monitoring exposure of animals at the San Francisco Zoo to PM_{10} because the animals are considered sensitive receptors. Monitoring data collected at the Westside Pump Station (upwind of the site) and Fort Funston (upwind control) indicate that average PM_{10} levels in the project vicinity

during the Lake Merced Transport construction project (February 1992 to March 1993) were as listed in Table 24.

TABLE 24: PM_{10} MONITORING DATA FROM AREAS NEAR RWTP SITE

Location	Average PM_{10} Concentrations in Micrograms Per Cubic Meter (ug/m^3)			
	Arithmetic Mean /a/	Geometric Mean /b/	Minimum Concentration	Maximum Concentration
Westside Pump Station	41.6	36.6	15.4	78.4
Fort Funston	19.3	16.7	7.9	38.9

/a/ The arithmetic mean is the average of a field of values displaying linear distribution. It is defined by the summation of n number of values divided by n. The National Ambient Air Quality annual arithmetic mean PM_{10} standard is 50 ug/m^3.

/b/ The geometric mean is statistical value that represents an "average" of a number data points with non-linear distribution. The geometric mean is determined by the nth root of the product of n number of values. The California annual geometric mean PM_{10} standard is 30 ug/m^3.

SOURCE: Environmental Science Associates, *Oceanside WPCP Construction Project, Environmental Compliance Summary Report, January 1989 - December 1994*, November 1994.

During this period, there were three violations at the Fort Funston monitor of the California Ambient Air Quality PM_{10} Standard of 50 ug/m^3 (over a 24-hour collection period) and 35 violations at the Westside monitor. While Fort Funston monitoring data indicate that PM_{10} levels are lower at Fort Funston than at the Westside Pump station, there are three factors that should be considered: (1) the Westside monitor was located immediately downwind of Great Highway and the beach, which are sources of PM_{10}; (2) Westside data reflects construction activities occurring upwind of the Westside site; and (3) the Fort Funston monitor was located in a very protected location, upwind of roadway sources and away from beaches.

Reservoir Sites and Transmission/Distribution Pipelines

No specific air quality monitoring data are available for proposed reservoir sites or transmission/distribution pipeline routes and corridors. However, air quality monitoring data presented above serves as a general indicator of air quality conditions in these areas. Sensitive receptors in the vicinity of reservoir sites or along pipeline routes/corridors include children who may use the Lincoln High School and McLaren Park sites.

GROUNDWATER MASTER PLAN PROJECT SITES

No specific air quality monitoring data are available for proposed well sites or along associated pipeline routes. However, air quality monitoring data presented above serves as a general indicator of air quality conditions in these areas. Sensitive receptors in the vicinity of well sites or along pipelines routes include children at Francis Scott Key School and children who may use the West Sunset Playground site.

I. NOISE AND VIBRATION

CITY OVERVIEW

Existing Noise Environment in the City

The existing ambient noise environment within the City is dominated by traffic and activities associated with residential, neighborhood commercial, and recreational uses. The Environmental Protection Element of the San Francisco General Plan indicated that in 1974 the project area was subject to background noise levels of approximately 60 dBA (Ldn) except at Golden Gate Park, McLaren Park, and the San Francisco Zoo/Lake Merced vicinity, which were subject to noise levels of about 55 dBA (Ldn).[1,2] In addition, the Environmental Protection Element indicated the following 1974 noise levels along major thoroughfares in the site vicinity:

Street	Noise Level (Ldn)
Great Highway	75 dBA
Sunset Boulevard	75 dBA
19th Avenue	80 dBA
Sloat Boulevard	70-75 dBA
Mansell Street	70 dBA

Applicable Noise Regulations

In the City, regulation of noise is stipulated in Article 29 of the Police Code, which states the City's policy is "to prohibit unnecessary, excessive and offensive noises from all sources subject to police power." Sections 2907 and 2908 of Article 29 regulate construction equipment and construction work at night. Relevant sections are presented as follows:

Section 2907(b) states "it shall be unlawful for any person, including the City and County of San Francisco, to operate any powered construction equipment, regardless of age or date of acquisition, if the operation of such equipment emits noise at a level in excess of 80 dBA when measured at a distance of 100 feet from such equipment, or an equivalent sound level at some other convenient distance." Exemptions to this requirement include:

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1 City and County of San Francisco, Department of City Planning, *San Francisco General Plan*, Environmental Protection Element, p. 1.6.13, 15.

2 dBA is a measure of sound in units of decibels (dB) on the A-weighted scale. The A-weighted decibel scale simulates the response of the human ear to various frequencies of sound.
Ldn, a day-night average noise level, represents a cumulative measure in decibels (dBA) of community noise during a 24-hour period. It applies weighting factors to account for people's lower tolerance to noise during the night (10 PM to 7 AM).

- impact tools and equipment with intake and exhaust mufflers recommended by the manufacturers and approved by the Director of Public Works as best accomplishing maximum noise attenuation; and

- pavement breakers and jackhammers equipped with acoustically attenuating shields or shrouds recommended by the manufacturers and approved by the Director of Public Works as best accomplishing maximum noise attenuation.

Section 2908 prohibits any person, between the hours of 8:00 p.m. of any day and 7:00 a.m. of the following day to erect, construct, demolish, excavate for, alter, or repair any building or structure if the noise level created is in excess of the ambient noise level by 5 dBA at the nearest property line unless a special permit therefore has been applied for and granted by the Director of Public Works.

In addition to construction activities, Section 2901.11 of Article 29 addresses unnecessary, excessive or offensive noise in general. It states that "unnecessary, excessive or offensive noise shall mean any sound or noise conflicting with the criteria, standards, or levels set forth for permissible noises. In the absence of specific maximum noise levels, a noise level which exceeds the ambient noise level by 5 dBA or more when measured at the nearest property line... shall be deemed a prima facie violation of this Article."

Sensitive Receptors

Sensitive noise receptors are generally considered to include hospitals, nursing homes, senior citizen centers, schools, churches, libraries, and residences (at night). Sensitive receptors in the vicinity of each project site are described in detail in Section IV.A, Land Use Setting (p. 112) of this report. Sensitive receptors are generally described below under each site.

RECYCLED WATER MASTER PLAN PROJECT SITES

Recycled Water Treatment Plant - Fleishhacker Pool Site

Noise measurements were taken to the south of the RWTP site in September 1993, after completion of the Oceanside Water Pollution Control Plant but prior to plant operation. Measurements were taken around the plant and a noise meter was left on the roof of the Administration building for one week. Short-term noise levels were measured at 53 to 70 dBA during the day and 54 to 63 dBA at night. However, measured levels were relatively elevated

because of on-going construction activities during the day and sludge delivery trucks at night.[3] Noise levels at the RWTP site would be expected to be similar to those measured at the Oceanside WPCP although the RWTP site is protected somewhat from traffic noise on the Great Highway Extension by a berm which is part of the West Side Pump Station.

Sensitive receptors in the site vicinity include uses associated with the San Francisco Zoological Gardens (including the animal collection at the Zoo) located immediately to the east, and residential uses to the north. Although the Rehabilitation Center for the Handicapped is located directly east of the Zoo, it is not expected to be affected by project construction at the Fleishhacker site since the center is separated from the project site by the Zoo.

Reservoir Sites

No specific noise data are available for proposed reservoir sites. Both reservoir sites are located on or adjacent to residential, recreational, and/or school uses. They are located in relatively quiet areas away from noisier commercial areas and major thoroughfares. The Lincoln High School reservoir site is located within the school campus boundaries. This school use and adjacent residential uses are considered sensitive noise receptors. The McLaren Park reservoir sites are located within the park. Nearby sensitive receptors include residences near Site 1 and an amphitheater near Site 2. Otherwise, recreational uses are not generally considered to be noise-sensitive.

Transmission and Distribution Pipelines

No noise data are available for specific pipeline routes or general pipeline corridors. In general, pipelines would be located along residential streets, some of which have relatively quiet noise environments.

GROUNDWATER MASTER PLAN PROJECT SITES

No specific noise data are available for proposed well sites or associated pipeline routes. New facilities designated in the GWMP for the Westside Basin are located in school playgrounds or parks. The noise environments in these areas are generally quiet, and are located away from noisier commercial areas and major thoroughfares. Sensitive receptors at the Sunset Well sites would be the adjacent schools and residences. The Powell Street BART dewatering reuse

[3] Environmental Science Associates, *Oceanside WPCP Construction Project, Environmental Compliance Summary Report, January 1989 - December 1994*, November 1994.

activities would be located underground and in a commercial area where there would be no sensitive receptors. Pipeline routes would be located along streets that are dominated by residential uses.

J. BIOLOGICAL RESOURCES

The two areas of potential biological resources impacts of RWMP and GWMP development are: landscape irrigation with recycled water and facility construction. This section presents the biological setting on and in the vicinity of each project site. The specific plants and communities that could be affected by the project facilities, as well as the specific nature of these effects, are described in more detail in the biological resources impact sections, V.A.10, p. 363, and V.B.10, p. 430, for the RWMP and GWMP, respectively.

LANDSCAPE IRRIGATION

As described in the RWMP project description chapter (p. 29), an estimated 67 percent of the projected recycled water demand is for landscape irrigation (see Figure 10, p. 35). Table 3 (p. 31) lists all the proposed recycled water users to be served. Most of the irrigation demand is for large, turf grass and landscape areas in the City's parks, schools and playgrounds including Golden Gate Park, Stern Grove, Harding Park, San Francisco State University, Lincoln Park, Presidio, and McLaren Park, and several public schools. Golden Gate Park would be the single largest user of recycled water overall, and the single largest landscape irrigation user. Recycled water would also be provided for irrigation of landscaped areas around large public and private facilities, such as Laguna Honda Home and the proposed Mission Bay development, and along roadway medians such as on Sunset Boulevard.

Plants to be irrigated with recycled water include primarily turf grasses, and also landscape areas that have been planted largely with non-native, ornamental species. Table 39, p. 368, presents a list of some of the more common plants found in parks and landscaped areas throughout the City.

Golden Gate Park presents the greatest diversity of plant species of any of the areas to be irrigated with recycled water. The City conducted a two-year pilot irrigation program in Golden Gate Park to investigate the sensitivity of a variety of plants to recycled water and to familiarize park staff with recycled water irrigation practices and management issues. The study included a wide variety of plant types including species commonly found in Golden Gate Park and other City park areas, as well as some of the less common species and the species potentially more sensitive to recycled water. The study included grasses, bedding plants, shrubs and tree species. The results of this study are summarized in the impact section (p. 367).

RWMP AND GWMP FACILITY CONSTRUCTION

The following assessment of biological resources at the proposed RWTP Fleishhacker Pool site, the two proposed reservoir sites, and the two proposed well sites is based on general site reconnaissance on December 30, 1994, a review of the literature, and informal consultation with resources experts and regulatory staff. A follow-up plant survey was conducted on March 15, 1995 at the two alternate reservoir sites in McLaren Park.

RECYCLED WATER MASTER PLAN PROJECT SITES

Recycled Water Treatment Plant - Fleishhacker Pool Site

Vegetation and Wildlife

The majority of the RWTP site is a paved parking-lot covering the area previously occupied by the Fleishhacker Swimming Pool, as can be seen on Figure 13, (p. 42), a layout of the site, and Figure 36, (p. 118), an aerial of the site. The northwest corner of the proposed construction may extend into a landscaped berm which separates the parking lot from the Westside Pump Station and the Great Highway. The berm is constructed of sand and supports a variety of introduced planted and naturalized species, along with some native species of plants. The toe or lower portion of the berm is covered with annual grasses, baltic rush (*Juncus balticus*), cape weed (*Arctotheca calendula),* bur clover (*Medicago polymorpha*), and ice plant (*Carpobrotus edulis*). Near the crest of the berm are Monterey cypress (*Cupressus macrocarpus*), green wattle (*Acacia decurrens*), Australian tea tree (*Leptospermum laevigatum*), Monterey pine (*Pinus radiata*), myoporum (*Myoporum laetum*) and tower of jewels (*Echium wildpretii*), all planted, non-native species. The western side of the berm, next to the pump station has been planted (or colonized) with beach evening primrose (*Camissonia cheiranthifolia*), dune sagewort (*Artemisia pynocephala*), sea rocket (*Cakile maritima*), ice plant, cape weed and New Zealand spinach (*Tetragonia tetragonioides*). No wildlife species were observed on-site but it is assumed that the site is utilized by small mammals such as house mouse (*Mus musculus*) and Norway rat (*Rattus rattus norvegicus*) and birds such as house sparrow (*Passer domesticus*) and Brewer's blackbird (*Euphagus cyanocephalus*).

Special Status Species

Monterey cypress, Monterey pine and eucalyptus trees are among the species utilized for over-wintering by Monarch butterfly (*Danaus plexippus*) in several places on the coast of California.

The Monarch is not listed by state or federal resource agencies as endangered but it may be designated as the national insect in the near future. No observations were made of Monarch butterfly over-wintering clusters and it is believed that the trees on the berm are too exposed to coastal winds to be appropriate for roost trees. No special status plant species were observed on site, nor were any expected given the "constructed" nature of the berm.

Lincoln High School - Reservoir Site and McCoppin Square Park - Construction Staging Area

Vegetation

The reservoir would be located beneath the school's football stadium, which is covered with turf grass and is surrounded by a dirt track. There are four large and two small Monterey pine trees on the slope at the north end of the field. The slope between the wall at the south end of the field and Santiago Street has five large (18" dbh [diameter-at-breast-height]) Monterey pine trees and a number of acacia trees.

In the north end of McCoppin Square Park, which is proposed as a construction staging area, there is turf grass and about thirteen mature trees, as can be seen on Lincoln High School reservoir site layout, Figure 15 (p. 51), and Figure 41 (p. 131), an aerial of the site. These trees include one large (24" dbh) Monterey pine, and 4 acacia trees planted along the park adjacent to Santiago Street. No tree removal is proposed. The level turf available is a 100-foot-wide band that extends 300 feet along Santiago.

Wildlife using this small park is most likely limited to common urban open space wildlife species, including house sparrow, house finch (*Carpodacus mexicanus*), Brewer's blackbird, American robin (*Turdus mitratorius*), house mouse, Norway rat, and an occasional skunk (*Mephitis mephitis*) or raccoon (*Procyon lotor*).

Special Status Species

No special status species were observed on the Lincoln High School football field or adjacent McCoppin Square Park, nor is existing habitat on these sites capable of supporting special status species. The trees are of appropriate species to serve as over-wintering sites for Monarch butterflies, but no butterflies were observed in the trees at the south end of the football field or in McCoppin Square Park. There is remote potential for the butterflies to occur at these sites in the future.

McLaren Park - Reservoir Site

Vegetation

Site 1. The approximately 2.5-acre site is located on the crest of John Shelley Drive, above the Upper Reservoir (see Figure 17, p. 54) for a reservoir layout showing site topography and the location of trees on and near the site (see also Figure 43, p. 135, which is an aerial photograph of the site area showing grassland and wooded areas). The site straddles John F. Shelley Drive and is approximately one-half paved and one-half introduced annual grassland. This grassland is made up of annual grasses and herbaceous plants such as perennial ryegrass (*Lolium perenne*), wild oats (*Avena* sp), filaree (*Erodium* sp.) and English ribwort (*Plantago lanceolata*), which are all introduced species, as well as native species, including buttercup (*Ranunculus* sp.), checker mallow (*Sidalcea malvaeflora* ssp. *malvaeflora*), sun cup (*Camissonia ovata*) and California poppy (*Eschscholzia californica*). There are nine small Monterey cypress and dwarf coyote brush planted in the median strip of the parking lot. At the east end of the site there is a grove of planted Monterey pine and eucalyptus trees.

Site 2. The approximately 2.5-acre is located adjacent to the intersection of Mansell Drive and Shelley Drive (see Figure 18, p. 55) for a reservoir layout showing site topography and the location of trees on and near the site (see also Figure 43, p. 135, which is an aerial photograph of the site area showing grassland and wooded areas). This area includes a large, flat area on the northwest and then to the east of the intersection a series of ridges and draws which extend north-south. The area slopes down to the northeast. The grassland area is covered with the annual and herbaceous plants species such as perennial ryegrass (*Lolium perenne*), bristly ox tongue (*Picris echioides*), English ribwort (*Plantago lanceolata*), wild radish (*Raphanus sativa*), which are all introduced, weedy species, as well as some native species, including extensive stands of meadow barley, buttercup (*Ranunculus* sp.), and California poppy (*Eschscholzia californica*). In addition, there are numerous bunches of native perennial California brome grass (*Bromus carinatus*), California oatgrass (*Danthonia californica*), meadow barely (*Hordeum brachyantherum*) and purple needle grass (*Nassella [stipa] pulchra*) and a patch of annual lupines (*Lupinus nanus* and *L. bicolor*).

Along Mansell Drive there are approximately 20 Monterey pine and cypress trees on or immediately adjacent to the proposed site. Down slope within 25 to 50 feet north of the site is a dense woodland of Monterey pines, cypress, and eucalyptus (*Eucalyptus globulus*). About 80 feet north and northwest of the proposed divided reservoir structure is an arroyo willow (*Salix lasiolepis*) thicket within a steep draw. This draw is one of several drainages within McLaren Park

which support native riparian vegetation.[1] A spring has been reported to exist within the densely vegetated draw but this could not be observed during field surveys.

The northwestern half of the proposed divided reservoir structure extends across the grassland to within 20 feet of another densely wooded area that covers a knoll to the northwest. Trees in this area include Monterey pine and cypress, acacia, and eucalyptus. There are three individual trees that occur adjacent to the reservoir site in this area and are considered to be within the area of potential direct impact.

Wildlife

The two sites are predominantly open grassland and may be foraging territory for raptors such as American kestrel (*Falco sparverius*) and red-tailed hawk (*Buteo jamaicensis*). American kestral forage for grasshoppers (*Schistocerca nitens*), several of which were heard calling from nearby trees, and red-tailed hawks forage for small rodents. Other wildlife expected to inhabit McLaren Park include western fence lizard (*Sceloporus occidentalis*), northern alligator lizard (*Gerrhonotus caeruleus*), gopher snake (*Pituophis melanoleucus*), northern flicker (*Colaptes auratus*), Anna's hummingbird (*Calypte anna*) house finch, western meadow lark (*Sternella neglecta*), American robin, house mouse, deer mouse (*Peromyscus maniculatus*), California vole (*Microtus californicus*), Botta's pocket gopher (*Thomomys bottae*), Norway rat, skunk and raccoon.

Special Status Species

No special status species were observed, nor was habitat capable of supporting special status species observed on or in the vicinity of either of the proposed alternative McLaren Park reservoir sites. The trees at Sites 1 and 2 are of the appropriate species to support overwintering Monarch butterflies. No Monarchs have been observed on or near these sites during site visits in 1993 through 1995. Preferred overwintering sites are characterized by a cluster of suitable trees in areas along the coast sheltered from the winds. The Monarchs may change overwintering sites, particularly if current sites are disturbed by human activity or eliminated as a result of development. The proposed reservoir sites at McClaren Park do not provide preferred habitat for these butterflies as the suitable trees occur at the crest of the hill and are not sheltered from the wing. There remains limited potential for Monarch butterflies to occur in this area in the future.

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[1] City and County of San Francisco Recreation and Park Department, *John McLaren Park Master Plan*, February 1989.

Transmission and Distribution Pipelines

Transmission and distribution pipeline alignments for the RWMP would lie almost entirely in paved City streets where no biological resources are present. The Fleishhacker RWTP site and McLaren Site 1 are immediately adjacent to paved roads in which pipelines are located. At the Lincoln site, the connection pipeline would run through the landscaped area on the school grounds between Santiago Street and the site. At the McLaren Site 2, the connection pipeline from the site to the pipeline in John F. Shelley Drive west of the site would be located in a 1,200-foot-long corridor of grassy area within the park.

GROUNDWATER MASTER PLAN PROJECT SITES

The project sites for the two Sunset District wells and the Powell Street BART Dewatering Well are paved areas with no biological resources, except for a line of Monterey pine along the northern edge of the West Sunset Playground site. The existing Elk Glen Well site in Golden Gate Park is located in an area of grasses adjacent to Elk Glen Lake. Emergent vegetation and large mounds of pampas grass and line the lake edge within 50 feet of the site to the west. Shrubs and trees, including mature Monterey pine and Monterey cypress lie within 50 to 100 feet of the site to the north and east. About 75 feet south of the site is a hill planted with cherry trees. Transmission/distribution pipeline routes would lie in City streets where no biological resources are present, except at the Elk Glen Well site, where the pipeline would run through paved and soft surface paths, about 120 feet to the main water line in Transverse Drive.

Lake Merced could be affected by the proposed In-Lieu Recharge Project (GWMP Short Term Activity 5C1). The In-Lieu Recharge project is intended to help raise and stabilize water levels in Lake Merced back to historic levels. The following provides an overview of the biological resources in the Lake Merced area.

Non-native landscaping along Lake Merced, on the east side of John Muir Drive, consists primarily of *Eucalyptus* spp., Monterey pine, Monterey cypress, *Acacia* spp., and Pittosporum. Dense clusters of these trees are found adjacent to a pedestrian trail along the northwest portion of Lake Merced. This type of vegetation continues along the western edge of the lake where there is a greater number of *Acacia* spp., Eucalyptus, and Pittosporum. Scattered along this area are isolated Monterey cypress and Monterey pine. Toward the east end of the southern lake, a large area of willow occurs along the pedestrian path and around the shore. In this area, the lake is surrounded by native bulrush, cattails, and willow. Ruderal exotic vegetation as well as native

yellow bush lupines are found in heavily used areas at the southern portion of the pedestrian path. Riparian vegetation consisting of bulrushes, tules, and red willow occurs on the south side of the pedestrian bridge across the lake.

With respect to special status species, the California Natural Diversity Data Base (CNDDB) lists the San Francisco gumplant (*Grindelia hirsutula maritima* var.), as "presumed extant" in the area of Lake Merced, although no plants were found in 1985; potential habitat exists on the south side of the Lake Merced pedestrian bridge.[2] San Francisco gumplant was not observed during a field survey on June 14, 1993.

Cliff swallows (*Hirundo pyrrhonota*) have been observed nesting on the underside of the Lake Merced pedestrian bridge. Cliff swallows are not a listed species, but are protected under the Migratory Bird Treaty Act of 1918. Sensitive animal species which have been recorded by the CNDDB in the vicinity of Lake Merced include: California black rail (*Laterallus jamaicensis coturniculus*), saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*), California red-legged frog (*Rana aurora draytonii*) (a Federal threatened species), Tomales isopod (*Caecidotea tomalensis*), and San Francisco forktail damselfly (*Ischnura gemina*). All of these are shown as "presumed extant" by the CNDDB, based primarily on relatively recent observations (generally in the 1980's). Field study by EIP Associates documented the presence of suitable habitat for the Tomales isopod. Suitable habitat for the San Francisco tree lupine moth was also noted in the field study, although the moth is not listed as rare, threatened, or endangered on either the State or Federal lists.

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[2] City and County of San Francisco, Department of City Planning, *Draft Environmental Impact Report - Bayside Discharge Alternatives (92.531E; SCH # 93023040)*, May 20, 1994.

K. CULTURAL RESOURCES

This section summarizes the results and recommendations of cultural resources studies completed by Archeo-Tech in September 1992, November 1992, January 1993 and April 1995.

An initial cultural resources investigation was conducted by Archeo-Tec in September 1992.[1] This investigation involved archival data searches for alternative sites that were under consideration at that time for development of facilities included in the RWMP. These sites are described in Chapter IX, Alternatives to the Proposed Project (pp. 502 to 524). The objectives of the investigation were to summarize the findings of previous cultural resources evaluations, provide an overview of historical evolution and development, characterize and identify cultural resource deposits, and recommend further, focused historical and/or archaeological study that might be deemed necessary. On-site surface reconnaissance of these alternative sites and also the Fleishhacker Pool site was subsequently conducted in November 1992 and January 1993.[2] An archival data search for Fleishhacker Pool was also performed at this time. Each site was surveyed in an attempt to locate and identify any traces of cultural resources which were visible on the ground surface. Because the majority of these alternative sites had already been subjected to intensive development, it was not possible to view any of the original soils on these sites. Therefore, the archaeological surface reconnaissance was unable to definitively rule out the presence or likelihood of subsurface resources.

As a result of the Alternatives Screening Analysis in 1994 (described in Chapter IX, pp. 502 to 524), a number of the alternative sites were eliminated and new sites were added to the RWMP. A limited review of relevant historical resources was therefore performed in April 1995 for new RWMP sites at Lincoln High School and McLaren Park and for new GWMP sites including the Elk Glen Well and Sunset District alternative well sites.[3] This review was performed to assess the likelihood of encountering subsurface prehistoric and historic period cultural resources at the RWMP and GWMP project sites.

These investigations concluded that there are no recorded archaeological or historic resources on the above-mentioned sites, but subsurface cultural and maritime resources may exist.

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1 Archeo-Tec, *San Francisco Draft Water Recycling Master Plan Cultural Resources Evaluation 92.371E*, prepared for the San Francisco Department of Public Works, January 13, 1993. A copy of this report is available for review at the Office of Environmental Review, 1660 Mission Street, San Francisco.

2 ibid.

3 Archeo-Tec, *In-house Archival Cultural Resource Overview Study of Selected Sites Associated with the San Francisco Recycled Water and Groundwater Master Plans EIR*, letter report to Environmental Science Associates, April 7, 1995. A copy of this report is available for review at the Office of Environmental Review, 1660 Mission Street, San Francisco.

OVERVIEW

Archaeological Resources[4]

The Spanish first explored Northern California during the latter part of the 18th century. It has been estimated that between 7,000 to 10,000 Native Americans inhabited the coastal area between Point Sur in Monterey County and the San Francisco Bay at that time. Native American shellmounds once dotted the shoreline of San Francisco Bay. According to site records on file at the Northwest Information Center, Sonoma State University, about 35 prehistoric sites have been officially recorded within the City and County of San Francisco; about one-third of these were found in the Hunters Point - Islais Creek area. Other areas in which prehistoric sites have been found include the South of Market/Civic Center Region, and in and around Fort Mason and the Marina District.[5] These sites consist mostly of a variety of shellmounds, but some of the sites on the eastside have included prehistoric human remains (burial sites) and midden deposits.

Many areas of what is now San Francisco presented favorable conditions for the settlement of Native Americans. Previous archaeological research in San Francisco has suggested that prehistoric resources may be encountered in remarkably diverse conditions. Sites have been found along beachfront sections of the City, while others have been found in inland areas. Only a small number of the total number of prehistoric sites in San Francisco County was ever systematically recorded. It is probable that many unrecovered sites were covered rather than destroyed. Recent archaeological work in San Francisco reveals that numerous relatively intact prehistoric deposits are scattered throughout various parts of San Francisco, and they appear to have been deeply buried beneath the region's sand dunes long before the beginning of the historic era. These sites are buried deep enough below the present ground surface to have avoided being disturbed by development.

Historic Resources[6]

The European population of the San Francisco Bay region increased steadily after Mission Bay and the Presidio were founded in 1776. Beginning in 1835, various ranchos within the northern San Francisco peninsula were granted to local individuals. There was little systematic

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4 All information in this subsection is from the *San Francisco Draft Water Recycling Master Plan Cultural Resources Evaluation 92.371E*, January 13, 1993, unless otherwise noted.

5 Archeo-Tec, *In-house Archival Cultural Resource Overview Study of Selected Sites Associated with the San Francisco Recycled Water and Groundwater Master Plans EIR*, letter report to Environmental Science Associates, April 7, 1995.

6 All information in this subsection is from the *San Francisco Draft Water Recycling Master Plan Cultural Resources Evaluation 92.371E*, January 13, 1993, unless otherwise noted.

development during this era, except for the development of a few widely scattered structures. Cattle grazing was the only documented economic activity within the general area during the entirety of the Spanish and Mexican eras (1776-1845).

The first documented reference to any type of development within the project area came in the late 1840s, when a settler by the name of George Green, Sr., established a farm on the property and later gained title to much of the land to the north of Lake Merced.

In the early 1850s, the California Gold Rush resulted in significant development, which was concentrated in and around Yerba Buena Cove, in the vicinity of present-day San Francisco's downtown area. As the City became more crowded, a systematic push toward the fringes of the City began; on the City's westside, facilities catering to recreational activities were developed. From the 1850s to at least the end of the 19th century, the areas surrounding Lake Merced, Ocean Beach and present-day Ocean Avenue and Sloat Boulevard became centers for various resorts, saloons, and race tracks.

The Spring Valley Water Company, incorporated in 1858, played a role in the development of the City's westside. By the final decade of the 19th century, the company (which, from the 1870s onward, owned all of the land surrounding Lake Merced as far north as modern-day Sloat Boulevard) was supplying water to the City of San Francisco from the Lake Merced reservoir. Beginning in the 1890s, the company began selling off lands in the Lake Merced area, and much of the land sold was to create a series of golf courses near the lake.

In 1899, the Spring Valley Water Company was forced to sell a section of its holdings along the beach west of the lake to the United States Army, which turned the land into a military reservation. The U.S. military base, officially named Fort Funston in 1917, was used in varying capacities through the end of World War II.

In 1922 the Spring Valley Water Company sold an additional 60 acres of property just north of Fort Funston to the City of San Francisco for the creation of a 1,000-foot-long saltwater swimming pool and adjoining playground, donated by banker and philanthropist Herbert Fleishhacker (the history of Fleishhacker Pool is discussed more fully below, pp. 246 to 249). By 1929, the attraction included a miniature railway and several caged lion cubs and monkeys, marking the start of the San Francisco Zoo.

Golden Gate Park was developed in the late 19th century. The land had been set aside as early as 1868, as a result of the "Outside Lands Act," and it was actively developed during the following decades. Another concession of the Outside Lands Act of 1868 was the reservation of a section of the Ocean Beach frontage which would become the Great Highway.

In 1981, the remains of two historical features were discovered in the Lake Merced Area: a well feature and a coal bin feature. Currently, it is unknown whether these two historic period cultural resources still exist.

In summary, there is no archival or historical evidence to indicate that any of the RWMP and GWMP sites currently being considered were developed or occupied until the late 19th century/ early 20th century era. There is no evidence to suggest that any of the sites under consideration are intrinsically associated with historically significant individuals or events.[7]

Along Ocean Beach, various shipwreck sites have been identified by researchers. For example, the hull section of an identified wooden ship was found buried about 25 feet below the ground surface directly beneath the Great Highway near the intersection of Sloat Boulevard. Partially excavated, a portion of this ship still lies beneath the Great Highway. Therefore, there is the potential for the recovery of maritime remains along Ocean Beach. The general locations of many potential shipwreck sites have been determined, but more sites may be present along this waterfront stretch.

RECYCLED WATER MASTER PLAN SITES

Recycled Water Treatment Plant - Fleishhacker Pool Site

The proposed Recycled Water Treatment Plant (RWTP) would be located at the Fleishhacker Pool site adjacent to the San Francisco Zoo. This site is part of the San Francisco Zoological Gardens.

Fleishhacker Pool, located at Sloat Boulevard and the Great Highway, opened on April 23, 1925, and was the world's largest swimming pool of its time. It was named in honor of Herbert Fleishhacker, a wealthy banker and the 1920's President of the Park Commission of San

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[7] Archeo-Tec, *In-house Archival Cultural Resource Overview Study of Selected Sites Associated with the San Francisco Recycled Water and Groundwater Master Plans EIR*, letter report to Environmental Science Associates, April 7, 1995.

Francisco, whose donations to the City's recreational facilities included development of the pool and adjoining Herbert Fleishhacker Playfield.[8]

Land was purchased from the Spring Valley Water Company for development of a swimming pool and golf links, and the pool was constructed during 1923 and 1924. It contained a uniquely designed circulation and heating system that kept 6,000,000 gallons of saltwater heated using the ocean's tides to fill the pool.[9]

The pool was an important part of the expansion and improvement of the City park system during the 1920s and 1930s, when there was a continuous recreation zone along the western edge of the City. Until the pool finally closed in 1971, it was open to the public every summer (except for a short period during World War II), for daily swimming as well as special events such as swimming competitions. The pool played a significant role in the recreational and cultural life of the City, particularly in the years before World War II.[10] The pool was filled in and covered with pavement in 1981.[11]

During a 1992 surface reconnaissance of the Fleishhacker Pool site and an archival data search, it was noted that the natural state of the Fleishhacker Pool site was very similar to its present condition. The site is characterized by relatively level sand and is only a few hundred feet from the Pacific Ocean. No prehistoric or historic sites have been recorded on this site. The nearest recorded prehistoric site is located at Fort Funston about 1½ miles south of the Fleishhacker site. No natural soils are visible.[12]

The Fleishhacker Pool site contains one structure, the Fleishhacker Bath House, which was located centrally along the western side of the pool. The Bath House was designed by Ward and Blohme in 1923-1925, in the Mediterranean style. The front facade is Ionic in design with a three-part central entranceway crowned with aquatic creatures and ornaments. The arrangement of the windows on the second floor on both pool side and ocean side consists of large squares of

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8 Charles Hall Page & Associates, Inc., *Report #1, Documentation of Historic, Cultural and Architectural Importance of the Fleishhacker Pool*, prepared for the San Francisco Zoological Society, August 15, 1977.
9 ibid.
10 ibid.
11 City and County of San Francisco, Department of Public Works, *San Francisco Recycled Water Master Plan, Draft*, July 1996.
12 Archeo-Tec, *San Francisco Draft Water Recycling Master Plan Cultural Resources Evaluation 92.371E*, prepared for the San Francisco Department of Public Works, January 13, 1993.

industrial sash that created well-lit spaces formerly used as restaurant dining areas.[13] The Bath House has light stucco walls and green-tiled hip roofs.

The Fleishhacker Pool site is not listed on the National Register of Historic Places or the California Register of Historic Places. The site was not rated in the 1976 Citywide Architectural Survey conducted by the San Francisco Planning Department nor has the area containing the site been surveyed by the Foundation for San Francisco's Architectural Heritage, and therefore, the structures are not rated by Heritage.

In the late 1970s, the Bath House was proposed for demolition to accommodate the Westside Pump Station project, located immediately north. The decision to demolish the pool and Bath House was opposed by several citizens' groups, which urged that the pool either be restored and reopened or be converted into a fresh-water pool and enclosed.[14] The City obtained the necessary approvals and implemented the required measures to allow the structure to be removed. The pool site at that time was considered eligible for the National Register of Historic Places (National Register).[15] A Memorandum of Agreement (MOA) was issued by the California State Historic Preservation Officer, the Environmental Protection Agency (Region IX) and the Advisory Council on Historic Preservation; the MOA concluded that avoiding the property would substantially increase the cost of the project and still not result in its preservation due to the prohibitive cost of its rehabilitation. The pool and Bath House were documented through photographs.[16]

Demolition of the Bath House ultimately was not required for the pump station project. A 1990 structural review of the Fleishhacker Pool facilities noted that the Bath House building is in a very deteriorated state and would require extensive repairs/reconstruction to restore it for occupancy.[17] In a 1992 study, the site's eligibility for the National Register was examined. The study determined that the action of filling in Fleishhacker Pool had compromised the historic integrity associated with the Fleishhacker Pool Bath House and that the site failed to meet the

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13 Charles Hall Page & Associates, Inc., *Report #1, Documentation of Historic, Cultural and Architectural Importance of the Fleishhacker Pool*, prepared for the San Francisco Zoological Society, August 15, 1977.

14 City and County of San Francisco, Department of City Planning, *West Side Transport/Storage Project Final EIR*, File No. EE75.304, certified July 28, 1977.

15 Environmental Science Associates, *San Francisco Draft Water Recycling Master Plan, Alternative Sites Assessment and Screening Study*, prepared for the San Francisco Department of Public Works, December 14, 1992.

16 Sara Pickus, Agency Liaison/Planner, San Francisco Wastewater Program, attachment to letter to Robert Bruce Anderson, Charles Hall Page & Associates, Inc., April 24, 1979.

17 John C. Burton, Principal, Rutherford and Chekene, letter to David Robinett, Assistant Zoo Director, San Francisco Zoological Gardens, October 9, 1990.

criteria for listing on the National Register. The study concluded that the Fleishhacker Pool site is not considered eligible for the National Register.[18]

The closest historical resource to the RWTP site is the Delia Fleishhacker Memorial Building, part of the original Fleishhacker Playfield and Pool development. This building, which is also called the Mother's Building, is listed on the National Register of Historic Places and is within the grounds of the San Francisco Zoo.

Reservoirs

A limited review of relevant historical resources was performed to assess the likelihood of encountering subsurface cultural resources of the prehistoric and historic periods at the Lincoln High School and McLaren Park reservoir sites.[19] This review determined that no recorded subsurface cultural resources of prehistoric/protohistoric age are known to exist within these sites, but unrecorded archaeological sites from this era may exist. This review also determined that there is no evidence to suggest that historic period subsurface cultural resources exist within, or immediately adjacent to, these sites, nor is there evidence to suggest that these sites are intrinsically associated with historically significant individuals or events.

GROUNDWATER MASTER PLAN SITES

Under the proposed GWMP, well construction activities could occur at the Elk Glen Well in Golden Gate Park and at Francis Scott Key School and West Sunset Playground in the Sunset District. These sites have been developed, and substantial surface disturbance has occurred on all sites.

A limited review of relevant historical resources was performed to assess the likelihood of encountering subsurface cultural resources of the prehistoric and historic periods at the Elk Glen Well and Sunset District Well sites.[20] This review determined that no recorded subsurface cultural resources of prehistoric/protohistoric age are known to exist at these sites, but unrecorded archaeological sites may exist. This review also determined that there is no evidence to suggest that historic period subsurface cultural resources exist within, or immediately adjacent

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18 Environmental Science Associates, *San Francisco Draft Water Recycling Master Plan Alternative Sites Assessment and Screening Study*, prepared for the San Francisco Department of Public Works, December 14, 1992.

19 Archeo-Tec, *In-house Archival Cultural Resource Overview Study of Selected Sites Associated with the San Francisco Recycled Water and Groundwater Master Plan EIRs,* letter report to Environmental Science Associates, April 7, 1995.

20 ibid.

to, these sites, nor is there evidence to suggest that these sites are intrinsically associated with historically significant individuals or events.